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15 August 1977

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POLITICAL AND SOCIOLOGICAL

HISTORY, PROPAGANDA WORK OF BROADCASTING ENTERPRISE OUTLINED

Peking WU-HSIEN-TIEN [RADIO] in Chinese No 1, 1977 pp 3-7

[Article by the Ideological Group, Bureau of the Central Broadcasting Enterprise: "The Red Radio Waves Send Deep Sentiments 10,000 Li"]

[Excerpts] While commemorating the anniversary of the death of Premier Chou En-lai, the great proletarian revolutionary and outstanding communist fighter, we broadcasting and television workers tearfully and emotionally gazed at the portrait of the late premier, held in both hands the inscriptions that Premier Chou had dedicated to the people's broadcasting enterprise, and remembered his sincere instruction to the broadcasting fighters.

On 15 November 1965, in commemorating the 20th anniversary of the founding of our people's broadcasting enterprise, Premier Chou wrote with his own hand, "Raise high the red flag of Chairman Mao's thought. Develop the revolutionary spirit of struggling hard amid difficulties and self-reliance, and strive for the development of the people's broadcasting enterprise." These 38 powerful characters fully showed his deep concern for the people's broadcasting enterprise and sincere expectations of broadcasting and television workers, and gave us invaluable instruction and great encouragement. Today, when reviewing Premier Chou's inscription, we seem to have gone back to the fighting years. The anecdotes of Premier Chou's sincere concern for the broadcasting workers clearly reappeared before our eyes one by one....

Our people's broadcasting enterprise was founded and developed under the leadership and personal care of our great leader Chairman Mao and beloved Premier Chou. Early in the hard times of the War of Resistance against Japan, Chairman Mao directed that the people's own broadcasting station be established in order to break the news blockade by the Kuomintang so that the army and the people throughout the country could directly hear the voice from Yenan. In 1940, following Chairman Mao's instructions, the Party Central Committee set up a broadcasting committee to assume the leadership of preparation work for broadcasting station construction. The chairman of the committee was the then Vice Chairman Chou En-lai.

At that time, due to the military encirclement and economic blockade by the Japanese invaders and the Kuomintang reactionaries, the military men

and people in the border area led a very hard life. The difficulties, both material and technical, in setting up a broadcasting station were unimaginable. But all the comrades were fully confident that, with the spirit of fighting amid difficulties and self-reliance taught by Chairman Mao and the leadership personally provided by Vice Chairman Chou, the construction of the radio station would be accomplished despite all the difficulties. Vice Chairman Chou, after overcoming difficulties, brought back a broadcasting transmitter from abroad. But when it was shipped to Yenan, many parts had been damaged due to rough traveling. With our own hands, we persistently fixed and installed it. But we still needed a generator. After repeated experiments, we solved the power problem by burning charcoal to propel an automobile engine. Thus, under the leadership of Vice Chairman Chou, we established our people's first broadcasting station in a cave at Yenan--the Yenan New China Broadcasting Station. This was a miracle in the world history of broadcasting. The Yenan station tried its first broadcast in the winter of 1940. On 5 September 1945, the Yenan station began its formal broadcast amid the song of victory of the War of Resistance against Japan. The red radio waves, breaking through the high sky, transmitted the sound of Mao Tsetung Thought to areas controlled by the Kuomintang, and to all over the country.

In November 1940, after coming back to Yenan from Nanking, Vice Chairman Chou immediately held a meeting to study the problem of battle readiness and evacuation of the Yenan station. At that time, Chiang Kai-shek's "full-scale attack" against the liberated areas suffered disastrous defeats, and he was about to switch to "attacks against key sectors." Vice Chairman Chou directed us that under this situation of war, broadcasts should not be interrupted and the voice of Chairman Mao and the Party Central Committee should be sent to every place in a timely manner. This meeting, under the direction of Vice Chairman Chou, made complete arrangements to assure uninterrupted broadcasting work during the time when the Kuomintang launched unceasing attacks on Yenan.

In mid-March of 1947, the evening before the Party Central Committee withdrew from Yenan, Vice Chairman Chou sent an important news script to the radio station. The newscaster, with full confidence in victory, made his last broadcast at Yenan. The station then moved to a temple of the God of Earth in a rugged valley at Wa-Yao-Pao and continued its broadcast.

This temple was the simplest radio station in the history of our people's broadcasting. The studio was only 4 square meters. The microphone was set on a table which originally was used to place sacrificial offerings. Right in this small temple we broadcast the exciting news of victory from the battle fields in northern Shensi and all over the country. In the afternoon of 25 March, Vice Chairman Chou was suddenly in front of us. He carefully inspected the machine room and sincerely encouraged us to do our work well. He particularly warned us to insure uninterrupted broadcasting. At dusk, after Vice Chairman Chou had left, Commander-in-Chief Chu also came to visit the broadcasting fighters. He quietly entered the studio, standing

behind the newscaster and listening to her broadcast. After the broadcast, Commander-in-Chief Chu excitedly said, "Our army fought a victorious battle at Ch'ing-Hua-Pian. Now they are examining the results. As soon as they get the results, you can broadcast this news." In the evening of 28 March, the newscaster, in a high pitch of excitement, broadcast the great victory at Ch'ing-Hua-Pian.

While the great leader Chairman Mao and Vice Chairman Chou were fighting from one battle to another in Northern Shensi, they always carried a radio operated by dry-cell batteries and listened to our broadcast and gave us instruction and encouragement in a timely manner. In early April 1947, Chairman Mao and Vice Chairman Chou came to Ch'ing-Yang-Ch'a. One day, they were listening to a broadcast after which Vice Chairman Chou praised the newscaster and said, "This newscaster did a very good job. She should be publicly cited." One day, at Wang-Chia-Wan, at the end of May, Chairman Mao and Vice Chairman Chou heard the news and the commentary about the great victory at Pan-Lung and the celebration party held at Chen-Wu-Tung. Chairman Mao excitedly said, "This woman comrade is really sharp. When she scolded the enemy, she spoke sternly and forcefully for the cause of justice. When she talked about our victory, she was able to cheer up the people. She really made a clear distinction between hatred and love. We should train more newscasters like her. Chairman Mao specially asked the New China News Agency to send us a complimentary telegram.

After liberation our people's broadcasting enterprise developed rapidly under close care of the great leaders Chairman Mao and Premier Chou. In 1965, Chairman Mao, with his very own hand, wrote an inscription, "Thrive to manage broadcasting well, serve the people throughout China and the world." This became the basic policy of our broadcasting work. Premier Chou was determined to thoroughly carry out what Chairman Mao had said in his inscription. On 9 April 1966, in an important speech at the Ninth National Broadcasting Conference, Premier Chou summarized Chairman Mao's directives concerning broadcasting work. He emphatically pointed out, "Under the guidance of Chairman Mao's strategic ideology, 'Be prepared against war, be prepared against natural disasters, and do everything for the people,' we should manage well broadcasting for the nation and the world. We should insure the safety and security of the broadcasting station and serve the people of China and the world." In order to carry out the important directions concerning broadcasting work by Chairman Mao, Premier Chou really toiled at his tasks.

Our great leader Chairman Mao concerned himself with the problems of millions of peasants listening to broadcasting. The National Program for Agricultural Development formulated under Chairman Mao's personal direction laid down a blue-print for the development of our broadcasting network in the rural areas. Our beloved and respected Premier Chou perseveringly carried out Chairman Mao's important instructions and firmly grasped the task of promoting broadcasting phonograph records, and television in the rural areas. On 27 August 1965 Premier Chou summoned the responsible

comrades of the broadcasting bureau and asked them in detail about the conditions of local broadcasting set ups such as county broadcasting stations, commune amplifiers, and the distribution of loudspeakers. Premier Chou directed that the content of local station programs relayed from the central station such as news, science, literature and arts should be well studied so as to meet the needs of the villages. Since the local stations were set up for the villages, the function was even greater. Revolutionary songs broadcast to the villages should be popular and easy to learn, such as "Sailing the Seas Depends on the Helmsman." The village could thus learn to sing. Since the audience for the records and TV programs was the villages, the content should be studied and suitable for them. In 1966, at the National Conference on Broadcasting Work, Premier Chou reiterated that broadcasting propaganda should be programmed for the villages. He said, "As soon as we are born, the first things we need are food and clothing. The materials and resources of food and clothing all come from the villages. For these 600 million peasants, we should educate them, support them, and encourage them." Premier Chou also directed that the village broadcasting network should be aggressively developed, rediffusing broadcasting should be linked with radio broadcasting, and a national broadcasting network should be established within 15 years. Today, the national broadcasting network that Chairman Mao had personally planned and Premier Chou had cherished so much has been established ahead of schedule. Nationwide broadcasting has reached 93.1 percent of the production brigades and 87.6 percent of production teams. The number of loudspeakers has reached 109,380,000. The target set by the National Program for Agricultural Development has been reached. Our country is a multi-nationality country. In order to propagandize Marxism-Leninism-Mao Tsetung Thought to the minorities, the Central Broadcasting Station began broadcasting to the minorities in 1950. But in 1960, the traitor and stooge Liu Shao-chi, taking advantage of the temporary difficulties of the national economy, started a gust of evil wind. The former Central Propaganda Bureau, following Liu Shao-chi's footsteps, broke up the broadcasting of the Central Broadcasting Station to the minorities without the knowledge of Chairman Mao and Premier Chou. In 1962, at a meeting on national work, Premier Chou learned about this matter and seriously criticized it saying, "Why was the national broadcasting stopped? Why wasn't I informed? Our country is so big, the area is so vast with so many nationalities, what can the Central Broadcasting Station do without a national broadcasting program?" Under Premier Chou's direction, the Central Station immediately started to resume its broadcasting to the minorities. In 1965, when the Tibet Autonomous Region was established, Premier Chou especially directed that transistor radios suitable for plateau areas be disseminated to each district and village. After that, Premier Chou many times inquired of the Central Broadcasting Station about the problems of national broadcasting. In 1971, under the close care of Premier Chou, the national broadcasting of the Central Station was finally resumed. The broad masses of Mongolian, Tibetan, Uighur, Kazakh, and Korean nationalities informed each other of the good news. Their eyes were filled with tears of joy.

Premier Chou paid special close attention to the central station's broadcasting programs for Taiwan. He personally examined and approved the policy of our broadcasting to Taiwan, and processed the letters received from the audience. In 1972, Premier Chou instructed us to add weather forecasting to the Taiwan program for the convenience of the Taiwanese fishermen. He even checked the script about a strong typhoon (grade 7) forecast in that year, and added a line at the end, which read, "Good night, fellow citizens."

Under the close care of the great leaders Chairman Mao and Premier Chou, Radio Peking's broadcasting beamed abroad developed rapidly. At the present time, Radio Peking has programs beamed to all places in the world in 39 languages. The respected and beloved Premier Chou was also concerned with Radio Peking. Whenever he had foreign visitors, he always asked them their opinion, suggestions, and demands on the programs of Radio Peking. He gave many important directions to the radio. While commemorating the anniversary of Premier Chou's death, we restudied his directions concerning the broadcasting bureau, his comments and directions on reports, and scripts personally edited by him. We reviewed his sincere teachings to us broadcasting fighters. This has deepened our memory of him. Premier Chou made himself a brilliant model in the propaganda work of the party.

Premier Chou unreservedly and ardently loved Chairman Mao. He always directed us to give first priority to propagandizing Chairman Mao. During the convention of the Ninth Central Committee of the Communist Party of China, Premier Chou instructed the TV cameramen, "Don't take too many shots of me, one or two will be enough. Focus your camera on Chairman Mao and the crowd." What an unostentatious work style and a noble mind! He was most concerned with Chairman Mao's health. Every time Chairman Mao had foreign dignitaries visit him he had to expose himself to the strong light to take pictures or movies, or TV videotapes. Premier Chou feared that the strong light and the long shooting sessions might have an adverse effect on Chairman Mao's health. So he directed the cameramen to improve their lighting facilities. Under the premier's directions, the concerned technology and research personnel, after repeated experiments, finally invented a type of lighting facility that shone brightly but had no adverse effect on one's health. He also directed the TV cameramen to drill in their basic skills--be both Red and expert, to take the shots of Chairman Mao in the shortest period of time. His sincere affection and close concern for the great leader Chairman Mao are always a good pattern for us to follow. Before he was hospitalized, Premier Chou still personally checked the TV video tapes on Chairman Mao's receptions for foreign guests. He was very serious about it and gave a lot of important instructions. Sometimes, he waited before the films were ready for him to check. After he was hospitalized, the "Gang of Four" took over the film inspection work. Chiang Ching, the paranoid "empress," had no feeling for Chairman Mao. When the TV video tapes on Chairman Mao's receptions for foreign guests were delivered to her, she was either playing poker or taking a stroll. She never checked the video tapes in time no matter how

urgent the tapes were. Worse still, she would make sarcastic remarks, "This is old stuff anyway." Compared with Premier Chou's sincere affection for Chairman Mao, how mean, ugly, reactionary Chiang Ching, the careerist, was!

Premier Chou seriously examined official documents, reports, and broadcast scripts. Not only did he guard the political path for us, he also corrected our errors in character use, or punctuation marks. In the early morning of 13 April 1971, after examining a sports news draft, he wrote this comment, "The explanation is too wordy--you don't need that many adjectives. I have already made corrections." From this comment, one could see how much trouble Premier Chou had taken to revise this broadcast script.

Premier Chou personally deployed all the important propaganda warfare. In the early 60's, Chairman Mao personally initiated a great struggle to criticize modern revisionism which took the Soviet revisionist renegade clique as its center. Under the leadership of the party Central Committee headed by Chairman Mao, the Central People's Broadcasting Station and Radio Peking broadcast a series of anti-revisionism manifestoes. This greatly encouraged the fighting spirit of the people throughout the country and worldwide Marxist-Leninist parties, organizations, and revolutionary people. The manifestoes also gave a fatal blow to the Soviet revisionist renegade clique. In the spring of 1963, Premier Chou and other Central leading comrades gave a reception at the Great Hall of the People for some 200 representatives of newscasters, editors, translators, and engineers from our bureau. He encouraged us to keep up with the good work and broadcast well the anti-revisionism articles.

On 29 August 1973, prior to the publication of the Party's 10 major news items, the Premier summoned two newscasters from the central station and explained to them the political significance of this press communique. He also explained the articulation of each paragraph, the speed of the name list, and how to pause, etc. He even designated the broadcasting time for this press communique.

In 1956, the Broadcasting Enterprise had a plan to build a broadcasting building in the capital. Premier Chou was very much concerned. He sent Comrade Chen I to the Broadcasting Bureau to check the construction model. He said he would come when he had the time. Afterwards we sent the building model to him. He checked the model seriously and meticulously; he approved all the necessary construction and disapproved the unpractical or unnecessary parts. Premier Chou resolutely carried out Chairman Mao's instruction of managing everything through diligence and frugality. This spirit gave us an unforgettable impression.

In 1959, after the completion of the construction, Premier Chou made an overall inspection. From the control room to the music hall, from the recording studio to the rehearsal studio; while he was checking the construction quality and quantity, he simultaneously carried on a sincere

conversation with the broadcasting fighters. When he came to the broadcasting studio of the Central People's Broadcasting Station, two newscasters were in the midst of broadcasting the program of "Unified Broadcast." He waited outside and listened to their broadcasting. After the program, he sincerely shook hands with them and thoughtfully said, "The construction of the broadcasting building is completed. The working conditions are much better than that of the Yenan cave. Be sure to carry out your work with the Yenan spirit."

Through all the testing, Premier Chou was Chairman Mao's close comrade-in-arms. He resolutely carried out and valiantly defended Chairman Mao's proletarian revolutionary line. After the start of the Cultural Revolution, the bourgeois careerist and conspirator Chiang Ch'ing shouted frenziedly, "We should take control of the broadcasting station which is a very important unit." Her intention to eject Premier Chou and usurp the leadership of the broadcasting bureau was undisguised. Chang Chun-chiao, Chiang Ch'ing, Yao Wen-yuan and their cohort Chen Po-ta many times sneaked to the broadcasting bureau to instigate struggles among the masses. At a meeting held on 28 October 1966, Premier Chou clearly pointed out that the New China News Agency, broadcasting stations, television stations, and news publishers were the tools of the proletariat. People outside should not disturb their work so as not to interfere with the broadcast of Chairman Mao's voice. The "Gang of Four" openly violated Premier Chou's direction and made trouble for the broadcasting bureau. They incited the beguiled students to attack the broadcasting station. They even approved stationing them at the broadcasting station.

After the usurpation of the propaganda leadership, the "Gang of Four" took advantage of using propaganda tools of radio and television to cook up counterrevolutionary opinion. They ferociously opposed Chairman Mao, Premier Chou, and Chairman Hua. They developed their own political capital. They opposed the brilliant inscription that Chairman Mao had written for the people's broadcasting enterprise. They changed the proletarian political direction of broadcasting and television. They attempted to use broadcasting and television as tools to cook up public opinion in order to usurp the party and the state power. They committed a monstrous crime.

On 8 January of last year, the respected and beloved Premier Chou died. When the broadcasting fighters heard the bad news, their hearts were broken and their eyes were filled with tears. Before the first line of the obituary notice was finished, the newscaster's voice was already broken. He mustered all his efforts to suppress his grief and continued his recording in order to broadcast this tragic news to the nation and the world. After the obituary notice was broadcast, our newscaster could no longer bear the grief. With tears in their eyes, the broadcasting fighters silently adorned themselves with black veils and white flowers, and picked up some pine branches. They prepared to hold a service in the memory of our respected and beloved Premier Chou.... But under Yao Wen-yuan's direct control, we were not allowed to carry on our memorial service. The broadcasting fighters silently suppressed their memory for the premier.

In the month of sorrows, with tears in our eyes, we were determined to diligently report Premier Chou's funeral activities to express our mourning for him. Our TV cameramen, constantly wiping their eyes, braved the chill to film the touching scenes in front of the Monument to the People's Heroes, on Ch'ang-an Street, in the factories, villages, troop units, schools.... But the "Gang of Four" popped up to interfere. Yao Wen-yuan gave the broadcasting and TV stations a list of things prohibited regarding remembrance of Premier Chou such as, mourning music, Premier Chou's pictures, the scenes of people who commemorated Premier Chou at Tiananmen Square, the funeral procession, newsreel about condolence given by foreign dignities.... This list of prohibitions fully exposed the ugly counter-revolutionary face of the "Gang of Four" who opposed Premier Chou. According to the original plan, the videotape that depicted people bidding farewell to Premier Chou's remains was to be shown for 3 days. But after 2 days of showing, Yao Wen-yuan gave an order and said, "Two days are enough, don't show any more." When the TV station was forced to cancel the program, the newscasters and technicians burst into tears.

The "Gang of Four" tried unsuccessfully to erase the splendid image of Premier Chou, suppress the people's unlimited respect for and memory of him. According to incomplete statistics, in the first week after the premier's death, the bureau of broadcasting received more than 1,000 phone calls and 130 letters. Many TV viewers broke down and wept over the phone, they asked the bureau to show a few more times the videotape about mourners paying their last respects to Premier Chou's remains. Many TV viewers and radio audience strongly protested and questioned who the broadcasting and TV stations represented. Why couldn't the people's broadcasting station reflect the people's will and voice? Some of the audience indignantly pointed out in their letters, "No one should block or suppress the vast masses' memory of and respect for the premier." The inquiry of the audience was well expressed. Were these phone calls and letters not an indignant condemnation and ruthless verdict upon the "Gang of Four"?

Like earth-shaking thunder in spring, the vast masses hailed Chairman Hua. The Party Central Committee headed by Chairman Hua, carrying out Chairman Mao's behests, with one move smashed the counterparty clique--the "Gang of Four." The leadership of broadcasting and TV was returned to the party. We broadcasting and TV workers and the people throughout the country vehemently hailed this great victory together.

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CSO: 4005

ECONOMIC

CHINA'S RAILWAY FREIGHT HAULING CREATED RECORD IN APRIL

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 12 May 77 p 1

[Article: "The Railways in the Entire Nation Present an Excellent Situation; the Number of Daily Freight Car Loading Creates a Record since the Founding of the Nation"]

[Excerpts] China's railway system created a record in April in the number of daily freight car loading since the founding of the nation, completed the monthly loading plan above norm, and realized ahead of schedule the indicator for May and June demanded by the National Railway Work Conference. Since the beginning of May, the number of freight car loading has continued to rise.

In April, a great enthusiasm appeared everywhere on China's railways. Among the 20 railway bureaus in the nation, 19 of them completed the transport plans ahead of schedule, and 11 of them created a record in history. The over-haulage freight in April throughout the nation was equal to operating 3,541 extra trains. The average weight hauling of the locomotives was a record in history and the freight train turnaround time was greatly shortened, averaging 18 hours shorter per train compared to February. The monthly plan of the state for the transport of such crucial resources as coal, petroleum, mineral ore, and chemical fertilizer were all completed above norm, and the average daily loading of coal was a record in history.

After the National Railway Work Conference, the enthusiasm for revolution and production in the relatively advanced railway bureaus of Canton, Shanghai, Peking, Liu-chou, Tsitsihar, Kirin, Tsinan, and Wuhan rose even higher. The Canton railway bureau completed the monthly plan for April 8.6 percent above norm and surpassed the record peak for the same period in 14 items of transport technical and economic indicators. In spite of the difficulty of freight car shortage, the Shanghai railway bureau still completed the state plan 13.2 percent above norm.

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CSO: 4006

TELEVISION BROUGHT TO MOUNTAINOUS WESTERN HUPEH

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 7 May 77 pp 4-5

[Article: "Western Hupeh's Mountain Region Vigorously Develops Television Industry"]

[Text] Since the Great Proletarian Cultural Revolution, I-ch'ang prefecture, Hupeh province, has vigorously developed television industry in the mountain region. The 10 counties and cities of the prefecture possess a television relay station and 7 television differential transfer stations, over 3,000 colored and black and white television sets, and 8 large-screen projection sets, bringing television to over 50 percent of the urban and rural populace of the prefecture.

Located in the mountain region of western Hupeh, the great majority of the villages of I-ch'ang prefecture are situated in mountainous and hilly areas. With the development of the mass movement to emulate Ta-chai in agriculture and Ta-ch'ing in industry, the material and cultural life of the broad masses of the mountain region has improved continuously. From the year 1970 on, the counties and cities conscientiously formulated overall plans to develop the television industry, determined to bring television to the mountain region of western Hupeh and the shores of the river gorges. With the vigorous support of the government units concerned, the prefectural committee made a special appropriation and rapidly built the Mo-chi mountain television relay station in the suburbs of I-ch'ang city. Tzu-kuei county, located in the depth of Hsi-ling gorge on the Yangtze River, selected Ta-chin-p'ing, 1,840 meters above sea level on Hsien-nu-feng, to build a television differential transfer station, relaying with good results the television signals, images, and sound of Wu-han, I-ch'ang, and Ching-chou in Hupeh and Ch'ang-te in Hunan.

With the development of television in the mountain region, the red and expert television technical ranks have grown rapidly. The broad work personnel work and learn simultaneously, gradually mastering the techniques of installation, adjusting, and maintenance and repair. The prefecture has preliminarily formed a television equipment maintenance and repair network. The counties and cities can locally service their television equipment, and some of them even manufacture some of the equipment.

6080
CSO: 4006

KIANGSU'S SMALL IRON AND STEEL INDUSTRY DISCUSSED

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 16 Mar 77 pp 1-2

[Article: "Kiangsu's Medium and Small Iron and Steel Industries Progress"]

[Excerpts] According to the information of the investigation unit of the Ministry of Metallurgical Industry, under the guidance of Chairman Mao's policy on fully developing local positivity, the local iron and steel industries of Kiangsu province have made rapid progress. In the recent 5 years, the iron and steel output has increased progressively 20 percent or more annually. When 1976 is compared to 1965, steel increased 5 times and pig iron 7.5 times. Currently, the province has formed a local metallurgical industrial system of a preliminary scale. The steel material produced in the province constitutes one-third of the volume needed by the province and pig iron for casting two-thirds, effectively supporting agriculture and promoting local industry.

After several years of effort, 8 counties (cities) out of the 11 counties (cities) of Chen-chiang prefecture have built 20 small mines and 7 counties (cities)have constructed small blast furnaces. The annual output capacities of mineral ore and pig iron have reached 150,000 and 80,000 tons respectively. Su-chou prefecture has the annual production capacities of 50,000 tons of iron ore, 30,000 tons of pig iron, and 60,000 tons of steel material.

The development of local medium and small iron and steel industries has provided favorable conditions for elevating the level of agricultural mechanization throughout the province. When 1976 is compared to 1965, the motive power for electromechanical irrigation and drainage in Kiangsu province increased 4 times, the number of large and medium tractors 5 times, the number of hand tractors 27 times, and the mechanized farming acreage 3 times. With the improvement of agricultural mechanization, the grain output of the province progressively increased 1 billion catties annually from 1966 to 1970 and 1.6 billion catties annually from 1971 to 1975.

INDUSTRY OF KWANGTUNG'S CHAO-CH'ING CITY DEVELOPS

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 19 Mar 77 p 2

[Article: "Kwangtung's Chao-ch'ing City Built Over 140 New Industrial Enterprises in the Past 10 Years"]

[Text] Since the Great Proletarian Cultural Revolution, Chao-ch'ing city, Kwangtung province, has built over 140 industrial enterprises of various fields. Currently, Chao-ch'ing, with 225 plants and mines, has become one of Kwangtung's new industrial cities.

Chao-ch'ing now has iron and steel, machine, instruments and meters, electronics, shipbuilding, and textile industries. Besides producing general farm machinery, chemical industrial products, people's daily need articles, and relatively precision machine tools, instruments and meters, and electrical machines, totaling over 1,000 products, the city also manufactures entire sets of equipment to equip small farm machinery, chemical fertilizer, insecticide, and iron and steel enterprises and small hydroelectric stations suitable for the local area.

The city's machine manufacturing is one of the industries which have developed comparatively rapidly. It now has over 20 machine plants, mass producing machine tools such as drills, milling machines, lathes, planes, general purpose grinders, and precision crank shaft grinders, entire sets of precision instruments and meters and serial electrical machines, and machine equipment and parts for chemical industry, farm machinery, metallurgy, shipbuilding, hoisting, motive power, and metal cutting and processing, totalling over 100 products. The output value of its machine industry last year increased 7 percent, equal to 6.5 times that of 1965. This year, the staff and workers of the machine industry have doubled their energy. The output of the 2 previous months increased 21.4 percent compared to that of the same period last year, constituting 75 percent of the plan for the first quarter and realizing a propitious start for the new year.

6080
CSO: 4006

BRIEFS

KWANGSI'S FIRST TELECOMMUNICATIONS BUILDING--The combined telecommunications building in Kwangsi's Kuei-lin city was completed on 16 January this year. The results of its operation indicate that all types of equipment and installations are up to the technical demands. The construction of this combined telecommunications building started in the spring of 1976, covering an area close to 8,000 square meters. The main building consists of five stories and the microwave tower eight stories. Located in the center of Kuei-lin city, it is grand and imposing, equipped with airconditioning, ventilation, and elevators. All the communications equipment contained in the building, with many kinds of communication means and functions, are domestically produced. Besides general telegram and telephone business, it also handles telephoto and microwave communication. [Hong Kong CHUNG-KUO HSIN-WEN in Chinese 10 Mar 77 p 3] 6080

TIENTSIN MACHINE TOOL INDUSTRY--Before liberation, Tientsin basically had no machine tool industry. After liberation, under the leadership of Chairman Mao and the Communist Party, its machine industry has flourished. Currently, the city has completed several dozen special machine tool plants and their corresponding assembling plants, supplying the state with many products, from small instrument and meter to large rolling and pressing machine tools, from all-purpose milling machines to lung-men milling machines, from ordinary and tool grinders to large guideway and high precision optical contour grinders, from electrolysis machine tools to entire sets of numerical control machines, casting and rolling equipment, measuring and cutting tools, and machine tools and optical instruments. The varieties and specifications of machine tools number over 200 and measuring and cutting tools and instruments up to 1,000. Since the Great Cultural Revolution, the broad workers, cadres, and technical personnel of Tientsin's machine tool industry have successively trial manufactured and plunged into production a group of products of an advanced level, such as boring machines, large electrolysis machine tools, high precision plane grinders, threaded grinders, 1,000-ton cold extraction machines, and numerical control line cutting machine tools. [Hong Kong CHUNG-KUO HSIN-WEN in Chinese 5 May 77 pp 6-7] 6080

NAN-NING NEIGHBORHOOD INDUSTRY--In 1950, the gross value of industrial output of Nan-ning city, Kwangsi Chuang Autonomous Region, was merely over 6 million yuan. Since the 1958 great leap forward, the worker class of the city raised high the banner of "An-shan Steel Constitution," intensively launched the movement to emulate Ta-ch'ing in industry, and promoted the rapid development of industrial production. In 1976, the gross value of industrial output of the city reached over 880 million yuan, and the varieties of products developed to over 2,000. During the 3d 5-year plan, the light industrial output value of the city progressively increased an average of 9.7 percent annually; during the 4th 5-year plan, the growth rate rose to 18.4 percent. Nan-ning city adheres to the policy of "small, native, mass" and successfully promotes neighborhood industry, which has become an important part of its light industry. Organizing the neighborhood residents and developing neighborhood industry result in solving the living problem of the residents, activating their socialist positivity, and producing large volumes of daily need industrial articles for the state. In 1976, the gross value of neighborhood industrial output throughout the city reached over 55 million yuan, increasing 4 times compared to that of 1970. The average annual growth rate for the past 6 years was 30.9 percent. [Hong Kong CHUNG-KUO HSIN-WEN in Chinese 12 May 77 pp 1-2] 6080

GROWTH OF SHANGHAI'S INDUSTRY--The gross value of Shanghai's industrial output in April was a record for the month and increased 6 percent compared to the same period last year. The 16 major light and textile industrial products, including cotton yarn, cotton fabric, bicycles, wristwatches, cameras, and cigarettes, all increased compared to that of the same period last year. Steel output increased 13.2 percent compared to that of March. The eight major chemical industrial products, including methyl alcohol, plastics, caustic soda, soda ash, drugs, chemical fertilizer, and synthetic ammonia, all made large increases compared to the same period last year. Among them, chemical fertilizer and synthetic ammonia increased over one-third compared to those of March and the same period last year. Such crucial machine and electrical products urgently needed by the state as high pressure pumps, special pumps, large foraging equipment, large pneumatic machines, and integrated circuit all made relatively large increases compared to March. Such major economic indicators as railway average daily loading and freight train turn-around rate all created a record in history. [Hong Kong CHUNG-KUO HSIN-WEN in Chinese 13 May 77 pp 1-2] 6080

KWANGSI'S RIVER NAVIGATION, SHIPBUILDING--Currently, the management of the navigational route on Kwangsi's Hung-shui river is both scientific and systematic. There are over 250 signals of all types along the route to facilitate navigation, assuring the normal passage of

ships. With the improvement of the navigational route construction, the navigation and transport enterprise of the river has greatly developed. All counties along the river have their own shipyards, building not only large wooden boats, but also 200-horsepower iron shell tugs, 120-ton iron shell barges, reenforced concrete boats, passenger ships, dredge boats, communication boats, and navigational signal boats. The passenger and freight shipping volume on the river has grown yearly. The freight shipping volume of 1976 was equal to over 220 times that of 1949, the beginning of liberation, effectively promoting the development of industrial and agricultural production along the shores of the river. [Hong Kong CHUNG-KUO HSIN-WEN in Chinese 14 May 77 pp 10-11] 6080

CSO: 4006

SCIENTIFIC AND TECHNOLOGICAL

NEW INSTRUMENT TO STUDY CARDIAC DISEASES DEVELOPED

Hong Kong TA KUNG PAO in Chinese 22 Feb 77 p 3

[Article: "Shanghai Produces Modern Instruments that Can Diagnose Cardiac and Other Diseases; Ultrasonic Graph Instrument Can Show Cardiac Anatomy Graph, Electrocardiograph, Cardiophonograph and Cardiograph"]

[Text] Ta Kung Pao News--According to news from Shanghai, striving to develop new medical instruments, the great masses of laborers, cadres and technical personnel of the Shanghai medical gauge instrument factory, closely cooperating with teachers and students of Fu-tan University, attempted and successfully produced a multi-head ultrasound graphic image instrument, making this modern examination instrument available for the diagnosis of cardiac and other diseases. Its greatest characteristic is that it can reveal the cross-section movement of the internal anatomical components of the heart. It is suitable for a wide range of uses, its use is simple and safe and there is no suffering or harm to the patient. It may be used in many examinations.

The multi-head ultrasonic graphic image instrument is made of two parts, the energy changing part (sound head) and the machine proper. When the ultrasound waves emitted from the sound head pass through the human tissues and encounter tissues with different anti-sound waves, a reflex occurs at this site which is magnified and transmitted to two 9-inch developing tubes to develop the image. On one screen may be seen a cross-section graphic image of the heart, on another screen may be see the electrocardiograph, cardiophonograph, and cardiograph reading. By studying these graphs it may be determined whether there is cardiac disease.

Clinical use has proven that this graphic image instrument has fulfilled the requirements of the technical plan. Most cardiac pathological disorders can be directly revealed. In addition, the use of this instrument has been used to study hepatic diseases, abdominal cystic diseases, gall stones and the fetuses, and generally the results have been good.

8774
CSO: 4008

USE OF LASERS IN SURGERY, OTHER MEDICAL FIELDS INCREASING

Hong Kong TA KUNG PAO in Chinese 1 Apr 77 p 7

[Article by the Laser Section, Shanghai Second Medical School: "The Use of Lasers in Medicine"]

[Text] The use of lasers is a new technique developed in the early sixties. Under the guidance of Chairman Mao's principle of "maintaining independence and keeping the initiative in our own hands and relying on our own efforts," laser technology in China has also attained rapid development, many new laser instruments have been incessantly studied and successfully produced, and a new appearance in the field of laser technology research has appeared. Regarding its use in medicine, a new phase has also been opened.

In discussing the use of lasers in medicine, people are more familiar with the use of the laser scalpel in surgical operations.

What is the difference between a laser scalpel and a metal scalpel or a high frequency electric scalpel?

We know that when the skin or muscles are incised or part of an organ is excised in surgical operations, the first problem encountered is bleeding. Especially in organs which have a rich blood supply bleeding during an operation may be profuse. A metal scalpel can only cut; it cannot stop the bleeding. By using a high frequency electric scalpel to perform surgery, not only can the skin and muscles be cut and tumors be excised, but also there are comparatively good hemostatic properties. Therefore blood loss will be comparatively less when the electric scalpel is used. It is possible to find a scalpel that is even more effective than high frequency electric scalpels regarding hemostasis? The discovery of lasers made this idea practical.

To verify the hemostatic properties of the laser scalpel, we performed the following experiment on seven healthy dogs: On both the right and left side of the thoracic wall of the same dog a horse-shoe shaped skin flap was mapped out; the length of the incision was 30 cm. The skin flap was elevated and everted and then sutured back. A carbon dioxide laser scalpel was used on

one side and an electric scalpel on the other side to make the incision. The volume of lost blood and the operating time were recorded and compared statistically. The experiment showed that: Using the laser scalpel, there was very little bleeding during the operation. Among the seven dogs, the blood loss was zero in one; the largest amount of blood lost was 3.6 grams; and the average was 0.84 grams. The average operating time was 5 hours and 5 minutes. When using the electric scalpel, bleeding was much more apparent than when using the laser scalpel. Among the seven dogs the least amount of blood lost was 2.51 grams; the most 28.27 grams; and the average operating time was 11 hours and 37 minutes. This experiment showed that in comparing the use of laser and electric scalpels, the laser scalpel is markedly superior in controlling bleeding, in decreasing clamping and ligation and in shortening the time of the operation.

Clinically we used the laser scalpel to excise skin carcinoma in over 20 patients and oral mucinous cysts and hemangiomata in over 50 patients. There was very little bleeding and the operating time was only several minutes. For example, we used a laser scalpel to excise a lower lip squamous cell carcinoma with a V-shaped all-layer excision. The operating time was 5 minutes, there was very little bleeding and the patient did not suffer. Using a laser scalpel to excise oral mucinous cysts, in most of the operations there was no bleeding at the incision and the operating time was only 1-2 minutes. After the operation, some patients looked at the laser scalpel and praised it saying: "Using a laser scalpel to remove a piece of flesh, not a drop of blood was seen. It was like magic."

From experiments on animals to clinical application, the greatest advantages of the laser scalpel are: there is more effective hemostasis than when using an electric scalpel during an operation, the operating time is greatly reduced, and there is very little suffering for the patient. Therefore, in the field of medicine, the hemostatic property of the laser scalpel may be fully utilized to develop surgery on organs which have rich blood supplies, such as liver and brain surgery. Besides, due to little bleeding when the laser scalpel is used, the operative field will be clear and the lesion will be fully exposed, thus making conditions suitable for radical excision of tumors.

Why does the laser scalpel incise tissues and have hemostatic properties?!

The reason lasers can incise skin and muscles and excise tumors, is that when laser beams pass through a lens and become focalized, there is a very high power density at that focal point. The focal point is the "knife point."

Whenever they come into contact with laser beams tissues immediately become vaporized and incised. The finer the focal point, the higher the power density on a unit area, the sharper the "knife point" and the greater the incising power. The cutting depth may be controlled by readjusting the distributing power of the laser beam instrument, or readjusting the speed of the knife head. Because there are 100,000 watts of power per square

millimeter at the incision point with the laser scalpel, therefore the temperature around the incision is high. When the tissues are incised, the incised edges are affected by the high temperature causing coagulation and closing of severed small blood vessels, thus creating the property of hemostasis at the time of incision.

Laser beams focused at a point may be used as a laser scalpel, but not all laser beams can be used as a laser scalpel. There must be continuous or high frequency high-power laser beams. At present high-power carbon dioxide lasers and yttrium-aluminum lasers are used as scalpels.

The above is a brief introduction to the use of the laser scalpel in surgical operations. But it is only one aspect of using lasers in medicine; it is not a complete picture of lasers in medicine. From a practical standpoint, the human eyeball is equivalent to a good set of optic equipment, and it is suitable for laser beam examination and treatment. Therefore the laser was first used in ophthalmology. At present it is used routinely for the treatment of certain eye diseases, treatment which is carried out for more than 20 diseases.

In recent years, the scope of laser use in medicine is gradually expanding. At present the lasers used for clinical treatment and diagnosis include the red ruby laser, neodynium-doped glass laser, yttrium-aluminum laser, carbon dioxide laser, argon laser, helium neon laser, nitrogen laser and helium-cadmium laser. Treatment methods include the simple laser scalpel first used, and developed to vaporization, cauterization, and radiation methods. At present the laser is used clinically in surgery, oralogy, dermatology, neurosurgery, ophthalmology, otolaryngology, and gynecology. It is used in the treatment of 86 kinds of diseases in these different departments. Among these diseases are life threatening tumors, difficult to remove hemangiomata, high incidence of cervicitis in women, lower limb ulcers that have caused the patients to suffer for many years, itching idseases that are resistant to medication, and various wart-like growths. The immediate treatment effects of lasers in these diseases are satisfactory.

The use of lasers is a new technique and it has been applied in medicine for only a short time. The number of diseases and the number of patients treated have been comparatively few, and the instruments used are still bulky. Especially in attempting to accurately and conveniently focus the laser beam emitted from the laser machine to the lesion requiring excision or treatment there remain at present very difficult problems. Due to the discovery of light fiber in recent years, the use of a flexible optic system may soon be developed.

8774
CSO: 4008

TREATMENT OF CARCINOMA BEING STUDIED, IMPROVED

Hong Kong TA KUNG PAO in Chinese 6 Apr 77 p 1

[Article: "Canton Carcinoma Specialist Discussion Revealed; Treatment Effect of Carcinoma in Our Nation Elevated; It Has Been Clinically Proven That Using Selaginella Doederleumu Hieron in Combination with Radiotherapy Shows Good Results; National Prevention of Carcinoma Meeting Soon To Be Held; Will Participate in World Conference Next Year"]

[Text] TA KUNG PAO, Canton, 5 Apr special--According to our reporter who obtained news from Canton, the treatment of carcinoma in our nation has been greatly elevated. At present, the tumor hospitals over the whole nation are carrying out the "attack three key points, grasp three earlies, lower two rates" movement.

Since the mid-sixties, the death rate among tumor (carcinoma) patients has been rising each year. In many nations and areas, the death rate from carcinoma in recent years is higher than other diseases, and carcinoma has become a disease occurring frequently. At present, the medical profession all over the world is making further studies covering the etiology of carcinoma and prevention and treatment methods. The 12th International Tumor Conference will be held in Argentina next year. The 4th National Tumor Meeting of our nation will be held in the middle of this year.

Before the national tumor meeting, this reporter had an opportunity to visit the Canton Tumor Hospital, had a discussion with several experienced tumor specialists, called on the doctor who had attended the 11th International Tumor Conference held in Italy, and extensively discussed the results obtained in tumor research in our nation, especially new developments in recent years. The specialists revealed that with the continuously increased life span of the people, there are more and more tumor patients. In recent years in many nations and areas the death rate due to tumors has rapidly increased, occupying first place in disease death rates. This is especially true in carcinoma of the esophagus, liver, blood, colon, uterus, nasopharynx, etc., which have been considered and managed as high incidence diseases, and are under intensive research and study.

Premier Chou Gave Instructions To Conquer Carcinoma; Tumor Speciality Hospitals Established in Provinces

Since 1963, in our nation the carcinoma death rate has also become the number one cause of death among diseases, high above severe infectious diseases such as cholera, smallpox, plague, schistosomiasis, etc. Therefore in 1969, our beloved Premier Chou gave medical personnel in this field many instructions to conquer carcinoma. Following his instructions, the provinces throughout the nation established tumor speciality hospitals, areas started tumor knowledge study classes one after another, trained large numbers of barefoot doctors, and propagated knowledge concerning tumors to the great masses of workers, farmers and soldiers, thus moving the focal point to the farms. In some areas, the main efforts of research were carried out in prevention and treatment in high incidence areas, making general surveys and early diagnosis, to accomplish early detection and early treatment with improved effectiveness. Before the Cultural Revolution, because doctors were sitting in the hospitals waiting for patients to come in for treatment, 80 percent of the patients were in the late and incurable stage when carcinoma was discovered, and early diagnosis was carried out in only 20 percent of the patients. But now there has been a great change. Doctors periodically carry out general surveys in the farms, and those rapidly increasing barefoot doctors have especially greatly changed the conditions. Thus 80 percent of the patients now are diagnosed early and only 20 percent are late cases. This has greatly improved the cure rate. For example, in a cotton mill in Shanghai with 540,000 women workers, a general survey has been carried out every year since 1958, and the incidence of cervical carcinoma has dropped fourfold; in Canton the incidence has also dropped 90 percent compared with 10 years ago.

Attack Three Keypoints, Grasp Three Earlies, Lower Two Rates; At Present Develop Early Treatment

To successfully attack the difficult barrier of carcinoma, the tumor hospitals all over the nation at present are actively taking part in work to attack three keypoints, grasp three earlies and lower two rates. Attack three keypoints means finding the etiology of carcinoma, early diagnosis and finding radical treatment methods; grasp three earlies means early detection, early diagnosis and early treatment; lower two rates means lower the incidence and lower the death rate.

Under the persistent research and experimentation of the great masses of medical personnel, some success has been achieved. Especially in early detection and early diagnosis, there is marked improvement, and at present the personnel are working on early treatment. According to them, patients suffering from carcinoma generally are weak physically, using radiotherapy and new drugs as practiced at present may severely affect one's health, and new drugs frequently cause other symptoms because of side effects.

To solve these problems, in 1970 doctors from the Canton Tumor Hospital and personnel from pharmaceutical factories went into the farms looking for

Chinese herbal medicines that have been effective among the people. With the assistance of commune members, a Chinese herbal medicine called Selaginella doederleunu Hieron [Shih Sheng Pai 4258 0006 2672] was discovered to be effective in the treatment of carcinoma. The farmers of the Pearl River triangular area have used this herb for many years, proving it to be helpful in the treatment of carcinoma. After many types of experimentation and clinical experiments, it was proven to be effective, especially when used in combination with radiotherapy. Therefore this herbal medicine was extracted and made by scientific methods into Selaginella doederleunu Hieron tablets, injections, and "carcinoma treatment tablets." After a trial period of many years markedly effective results were shown.

In 1971 a 54-year-old female was examined at the Canton Tumor Hospital. A mass about the size of a duck's egg was found in the right upper lung and carcinoma cells were found in the sputum. After many examinations the lesion was proven to be carcinoma of the lung. With such a large mass, if radiotherapy is immediately carried out, it can easily cause pneumonia or even fibrosis. To avoid such complications, it was decided to first give her "carcinoma treatment tablets." After 1 month the mass became smaller, about the size of a chestnut. It became even smaller in another half month. Then radiotherapy was carried out, the results were excellent, and the patient was soon discharged. In the past, if a woman had a malignant hydatidiform mole a hysterectomy had to be performed or the condition could not be treated, but at present if this condition is detected in time, surgery may be avoided, and taking medicine may solve the problem. A recently married young woman was admitted to the hospital in September 1971 because of a malignant hydatidiform mole. The doctors decided to give her "carcinoma treatment tablets." The condition was rapidly cured, and in the latter part of 1972 the woman gave birth. This broke with the former tradition for treating this condition.

Using Chinese herbal medicine to treat carcinoma is a new development of our medical science and has attracted the attention of the medical profession of other nations throughout the world. At present, the great masses of medical personnel of our nation are continuously striving hard to successfully attack this difficult barrier--carcinoma. It is believed that in the not too distant future, this formerly considered "incurable disease," carcinoma, will be controlled and bow its head to the people.

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CSO: 4008

MEDICAL INSTRUMENT INDUSTRY INCREASES PRODUCTION

Hong Kong TA KUNG PAO in Chinese 6 Apr 77 p 1

[Article: "Our Nation's Medical Instrument Industry Utilizes Electronuclear Techniques; Many Products Have Reached or Approached Advanced World Standard"]

[Text] NCNA, Peking, 5 Apr 77--The great masses of staff member of the medical instrument industry front in our nation, holding high Chairman Mao's great banner, positively carried out Chairman Hua's strategic decision concerning grasping the key link in running the country, exposed and criticized the counterrevolutionary crimes of the "gang of four," and profoundly carried out the mass movement of "in industry learn from Ta-ching," thus making the revolutionary and production appearance better and better.

In 1976, under the severe conditions of the "Four Harmfuls" and natural calamities, the great masses of staff members of the medical instrument industry front fought against the "Gang of Four" and against earthquakes, and attained comparatively good success. The total production value increased 11.8 percent compared with 1975. Most provinces, cities and autonomous regions were able to exceed their annual production plan. There were 48 new items that were successfully produced, such as indirect fluoroscopic photographic machine, chemical refrigerators, high transparency fluoroscopic screen, radiotherapy localization model machine, and peritoneal dialysis machine. Some of these fulfilled requirements of the farms, others fulfilled what were lacking in our nation. In Chekiang Province which was deeply affected by the "Gang of Four," due to new born capitalist Wang Hung-wen instructing counterrevolutionary Weng Sen-ho to incite mass fighting, splitting the force of the working class, and inciting work and production stoppages, the production value of medical instruments in the first half of last year in the whole province was only 30 percent fulfilled. After crushing the "Gang of Four," the revolutionary positive attitude of the great masses of staff members reached unprecedented heights, medical instrument production markedly increased in the fourth quarter of last year, not only recovering the damage caused by the "Gang of Four," but even surpassing the annual plan by 3.8 percent. Last year severe earthquakes occurred in the Tang-shan and Feng-nan areas. The staff of the Tien-tsin medical instrument industry front displayed a heroic fearless manner in fighting the earthquake. The earth

shook severely and the people worked harder. Not only was there no reduction of production because of the earthquake, but production was increased 16.5 percent over 1975.

In the past few years, the great masses of staff members of the medical instrument industry front conscientiously carried out the great instructions of Chairman Mao concerning "in medical health care work put the stress on the countryside," increased the production of medical instruments that are used in the prevention and treatment of common and high incidence diseases, on a large scale increased production of products that are needed in the farms, and contributed to the improvement of medical health conditions there. Since 1972, under the principle of first supplying minority tribe areas, severely cold areas, cattle breeding areas and old revolutionary base areas, the health centers of farm communes have been supplied with equipment in batches and groups. At present, over 60 percent of the health centers in farm communes all over the nation have been equipped in different degrees; county hospitals, county infectious disease prevention stations and women and children's health stations have received new and necessary replacements of medical equipment. The supply of instruments necessary for birth control in cities and the farms is basically sufficient. In producing large quantities of medical instruments for common use, the great masses of staff members at the same time have also striven to study and produce new instruments for the diagnosis and treatment of common and high incidence diseases. They have used modern scientific techniques such as electrons, nuclear power ultrasound waves, hypothermia, laser beams, infrared rays, and fiber beams, making a good start. Over 200 kinds of new products have been successfully produced in the past few years, and some of them have attained or approached advanced world standards.

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CSO: 4008

PEASANT'S BLAST-SEVERED ARMS REATTACHED, RESTORED TO USE

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 24 May 77 p 5

[Article: "Hospital No 145 of the People's Liberation Army Successfully Re-attaches Both Arms Severed in a Blast Injury"]

[Text] Chinese News Service, Chi-nan, 21 May 77--Hospital No 145 of the People's Liberation Army successfully re-attached both arms severed in a blast injury for poor peasant commune member Liu Hsiao-chih. Concerned organizations considered this another happy success on the medical front.

According to past experience, severed extremities caused by blast injury usually resulted in loss of the complete extremity making re-attachment impossible. Hospital No 145 followed the teaching of Chairman Mao "Save from mortal danger and heal the wounded, carry out revolutionary humanitarianism," overcame many difficulties, successfully re-attached both severed arms, thus breaking through past experiences and creating new experiences. These experiences may be used by other units, to save more severed limbs.

The incident occurred on 21 March last year. a 24-year old poor peasant commune member Liu Hsiao-chih of Ch'ih-shan commune, Fan-hsin brigade, Shantung, Lai-yang Country, was involved in an accidental explosion while removing dud explosives. Besides injury to the face and chest, both arms were completely severed. From the mid-portion of the right arm to the wrist, about 10 cm of soft tissue and bone was blown off, with a small bit of muscle and two nerves still connected; the bone at the mid-portion of the left arm was blown to pieces, the muscles were severed and everted, and most of the blood vessels were cut. When Liu Hsiao-chih was sent to Hospital No 145, he was in a state of severe hemorrhagic shock. After emergency treatment he was out of danger. How to treat the two severed arms of Liu Hsiao-chih? Everybody was determined to use the revolutionary spirit of "nothing is hard in this world if you dare to scale the heights," to overcome the difficulties, date to practice, to re-attach and restore both arms of Liu Hsiao-chih.

Vice superintendent Hsu Pao-shan and assistant chief surgeon Hua Shou-hsin of the Surgery II Department who were in charge of the operation, first concentrated on thoroughly cleaning the wound. Severely damaged muscle tissues

were boldly excised to protect against post-operative infection of the sutured wound. They also grasped the main contradiction of blood vessel anastomosis, boldly excised severely damaged vessels, and used excised saphenous veins from the thigh for transplantation to restore good circulation to the re-attached severed arms. After the operation, severe burning neurodynia symptoms occurred in the re-attached limbs of the patient. The medical personnel repeatedly discussed and analyzed the condition, reviewed the literature and visited other medical units, clarified the etiology of burning neurodynia, changed the previous treatment methods and used operative measures to overcome the burning neurodynia. In the late stage of treatment, to help the re-attached limbs to recover their functions, medical personnel carried out a number of operations, and assigned special personnel to help direct physical therapy. After more than 300 days and nights of careful treatment and nursing care, the two re-attached blast-injured arms of Liu Hsiao-chih recovered their functions.

On 2 February of this year, Liu Hsiao-chih recovered and returned to his commune. He wrote with his two re-attached hands: "The Party gave me a second life; our beloved People's Liberation Army gave me back my two hands. Under the leadership of our talented Chairman Hua, I will use these two new hands to contribute all my strength to socialist construction." The Lai-yang County Party secretary represented the poor and lower-middle peasants of the whole country, presented a banner on which were embroidered the words "The love of the army and people are as deep as the sea; the medical technique shines with brilliant colors" to Hospital No 145.

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CSO: 4008

FU-SHAN SANITATION WORK INCREASED

Hong Kong CHUNG-KUO HSIN-WEN in Chinese 25 May 77 p 2

[Article: "Sanitation Work in Kwangtung Province, Fu-shan]

[Text] Chinese News Service, Canton, 24 May 77--The national urban sanitation work model unit--Kwangtung Province Fu-shan city--for many years persisted in developing the patriotic sanitation movement and has become better and better in its urban sanitation work.

Before liberation there were 'five many' in Fu-shan city, that is: many dirt water ditches, many piles of garbage and broken tiles, many mosquitoes and flies, many infectious diseases, and many religious rituals. After liberation, people of the whole city became enthusiastic with the great call of Chairman Mao "Mobilize the people, study sanitation, eliminate diseases and raise the health standard." Every year several forceful patriotic sanitation movements were carried out, more than 86,000 meters of sewage lines were fixed and repaired, forming a sewage system in the whole city; the longest ditch 8,000 meters long was dredged clear; a large swamp area north of the city was filled in, and a beautiful scenic artificial lake of more than 10,000 square meters was built. The backward sanitary appearance of the whole city was basically changed.

In 1960 the city was judged a national urban sanitary work model unit, and received the praises of our great leader Chairman Mao. Our beloved Premier Chou personally suggested holding the national urban sanitary work conference at this place, and enthusiastically encouraged the people of Fu-shan to 'maintain its glory.' This gave the people of Fu-shan great encouragement and education. Since the Cultural Revolution, Fu-shan city has further broadly and deeply carried out patriotic sanitation movements, coordinating with the requirements of socialist construction. Every year the people of the city have improved the city's appearance, fixed the sewage system, widened streets and roads, and so on. In the whole city, all the over 1,300 streets and small lanes have been completely repaired. New accomplishments in the sanitary field have been incessantly obtained. Now the number of households

which have won the honor of being called 'sanitary family' in the whole city have increased 63 percent as compared with 1965 and sanitary model units have increased 150 percent as compared with 1965. Since liberation, for over 20 years, there have been no severe infectious diseases such as cholera, plague and smallpox, in the city. Since the Cultural Revolution, there has been no diphtheria, whooping cough, tetanus, fasciolopsis, leptospirosis, etc., and the incidence of other infectious diseases has also been greatly reduced, thus effectively raising the health standard of the people.

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CSO: 4008

GANG OF FOUR'S INTERFERENCE IN EARTHQUAKE WORK CITED

Peking WU-LI [PHYSICS] in Chinese Vol 6 No 1, Feb 77 pp 5-6

[Article by Tai Wien-tsu, Institute of Natural Science History, Chinese Academy of Sciences: "The Vicious Plot of the 'Gang of Four' To Meddle in Scientific and Technical Circles"]

[Excerpt] II. Raise an Evil Wave of Criticizing "Emphasis on Theory," Organize Encirclement Against Premier Chou's Directive

The acute struggle between the two classes and between the two lines, unfolded around the problem on the basic theory of natural science, also shows clearly that the "Gang of Four" pointed the spearhead of their attack at Premier Chou and Chairman Mao. Their plot was very vicious.

Engels pointed out: "To stand on the highest peak of science, a nation cannot dispense with theoretical thinking even for a moment." (Engels, "Natural Dialectics," the People's Press, 1971, p 29) Premier Chou had always paid great attention to the theoretical study of natural science according to the basic principle of Marxism-Leninism. In 1970, Premier Chou followed the spirit of Chairman Mao's "On Practice," and instructed the Chinese Academy of Sciences to raise high scientific research on the basis of going broadly and deeply into realities, to undertake some work of basic research and to raise practice to its due theoretical high level. Later on, Premier Chou again issued his directives and repeatedly laid emphasis on this problem.

Moreover, in 1972, according to the spirit of Chairman Mao's directives, he himself made arrangements for Comrade Chou P'ei-yuan of Peking University to advocate the theoretical work of natural science. All the scientific and technical workers were elated and inspired by this series of brilliant directives from Premier Chou, and formed their determination to carry them out. However, the "Gang of Four" took Premier Chou's instructions as thorns in flesh and were extremely annoyed. They not only refused to carry out these instructions but frantically organized encirclement and suppression. After Comrade Chou P'ei-yuan, acting in the spirit of Chairman Mao and Premier Chou's directives, had written an article for

PEOPLE'S DAILY, "My View on Revolution in Scientific Education of Comprehensive Universities," Yao Wen-yuan, the scholar-villain, appropriated the power he had usurped to control tools of public opinion, would not let PEOPLE'S DAILY publish it, transmitted it to KUANG-MING DAILY and appointed somebody to take it to Shanghai on the pretext of seeking comments but actually for writing articles to attack Premier Chou. After Comrade Chou P'ei-yuan's article was published, Chang Ch'un-ch'iao, the wicked schemer, clamored madly: "Chou P'ei-yuan has supporters backstage. No matter how big and how powerful is his supporter, we shall still criticize him!" The spearhead was pointed directly at Premier Chou. Not long afterwards, WEN HUI PAI of Shanghai, then under the "Gang of Four's" control, put out scores of articles forming an encirclement of attack, turning things upside down, confusing right and wrong, babbling that "mentioning at present the emphasis on basic theory means isolating theory from reality" and "just as Liu Shao-ch'i did, trying to take the road of turning back," using extremely malicious language, making an all-out attack and framing all sorts of charges. The "Gang of Four" as evil-doers sabotaging both practice and theory schemed singlehandedly for this counterrevolutionary encirclement and suppression, with the aim of not only undermining socialist scientific and technical work but of opposing Premier Chou and Chairman Mao. Such a despicable and malicious performance could only be staged by this counterrevolutionary black gang with deep hatred against the party and against the people.

III. Sabotage Seismological Forecasting and Anti-Quake Relief Work, Commit Towering Crimes Against People

The "Gang of Four" carried out activities of interference and sabotage everywhere to usurp party and state power in China's scientific and technical circles, and brought about very great confusion ideologically, politically, organizationally and professionally. Scientific and technical work suffered very great damage and loss. The consequences are very serious. The failure of forecasting the T'ang-shan earthquake has caused historically rare damage and loss to people's lives and property and, moreover, become our complaint of blood and tears against the "Gang of Four" for their towering crimes.

Peking, Tientsin, T'ang-shan, Po-hai and Chang-chia-k'ou areas are key observation areas which the Party Central Committee has time and again laid emphasis on. As early as in 1966 after the Hopei earthquake, Premier Chou at once gave instruction to pay close attention to the trend of quakes in Peking and Tientsin areas. After the Hai-ch'eng earthquake in 1975, Comrade Hua Kuo-feng also gave instructions more than once that all earthquakes of magnitude 5 and higher in Peking and Tientsin areas should be forecast 24 hours in advance. Suggestions have long been made for making periodical and long-term forecasts in these areas. Year before last it was being said that within 2 years some destructive earthquakes of and above grade 5 might possibly occur in Peking, Tientsin, T'ang-shan and Chang-chia-k'ou areas. Last January, at the National Conference on the Trends of Earthquakes, the region including areas around Peking, Tientsin, T'ang-shan, Pohai and Chang-chia-k'ou was listed as one of the four

dangerous regions in the whole country under key observation in the current year. It was pointed out that in this region there was a background for the occurrence of quakes of 5-6 grade. It was further pointed out that special attention should be paid to the northeastern part of Hopei Province. Since June, various unusual phenomena had frequently appeared. In July a large number of pre-quake short-lived abnormalities emerged, and many instruments also observed a great many obvious unusual changes. In the first half of July, the State Seismological Bureau had continually received a good number of reports of prediction and suggestion from professional and spare-time survey organs, and realized the serious situation of earthquakes. At the very moment when the danger of a major quake was approaching day by day and the seismological workers were worried to death, the "Gang of Four" and their followers stepped up their counterrevolutionary conspiratorial activities in the State Seismological Bureau. Even in July this gang of imposters of revolution paid no heed to the tense earthquake situation in the Peking-Tientsin-T'angshan-Changchiak'ou region, opposed Chairman Hua's directive, disobeyed the Party Central Committee and went farther and farther on the road of counterrevolution. They impatiently usurped the party and state power in the Seismological Bureau, replaced those who refused to follow them with their henchmen, grabbed power level by level, disorganized the leading group, disrupted the work of the bureau and created unrest among its working personnel. They made no effort at all to conduct a serious study of the earthquake situation, and even turned a deaf ear to forecasts of an imminent major earthquake. In this way, on July 28 a catastrophic earthquake broke out without warning in T'ang-shan. These hard facts prove that the failure to forecast the T'angshan major earthquake was a serious tragedy created by the gang and their henchmen who frantically interfered in and sabotaged seismological work. We must settle accounts thoroughly with them, and resolutely make them repay their debts of blood owed to the people!

The Party Central Committee headed by Chairman Mao showed great concern for the people in the calamity-stricken areas. After the occurrence of the major earthquake in T'ang-shan, it immediately sent a telegram of sympathy to the earthquake region. Premier Hua Kuo-feng, on behalf of Chairman Mao and the Party Central Committee, personally visited the stricken people, unfolding a touching scene of people rushing from all directions in support of an afflicted area. To keep a close watch over the disaster, and to protect Chairman Mao, the Party Central Committee, the capital and people's lives and property, Comrade Hua Kuo-feng and other leading comrades of the Central Committee fought day and night together with the seismological workers, listened to reports on the disaster and gave important instructions promptly. On the contrary, the "Gang of Four" paid no heed at all to sufferings of the afflicted, and took the lives of millions in the stricken areas as trifles. They not only remained hiding in a dark corner, but led a thoroughly debauched and corrupt life, never listened once to reports on the disaster, but also howled like wild beasts: "Tangshan has only 1 million people, our country has 800 million people and 9.6 million square kilometers of land; it's nothing if Tangshan is wiped out!" Yao Wen-yuan the scholar-villain took

the natural disaster as an auspice for them to "set up a new everlasting celestial dynasty." Wang Hung-wen, the political rogue, and Chiang Ch'ing, the White Bone Demon, flagrantly slandered the responsible comrades of the Central Committee, Hopei Province and T'ang-shan area actively leading the struggle against the quake and for relief work as "capitalist roaders frightened and caught unaware." Leading comrades of the Central Committee instructed more than once the Kailuan Coal Mines to drain water and restore production, and were also slandered by the "Gang of Four" as "laying emphasis only on productivity" and "talking like capitalist roaders." Thus, the "Gang of Four" revealed completely their counterrevolutionary ugly features of frantically sabotaging the anti-quake and relief work, standing on the corpses of the victims of the earthquake and taking the opportunity to usurp the party and state power. They had gone to the extreme in making malicious schemes and merciless plots, and could do nothing worse. All people in the country are indignant at their crimes and unanimously denounce them!

The "Gang of Four" as an anti-party clique had done still more bad things in the scientific and technical circles. They had committed countless crimes. However, the foregoing instances alone sufficiently prove that they were "those who take fishing in troubled waters, carrying out plots step by step and winning a final victory as their appraisal of the current situation and their ultimate goal." (Mao Tse-tung, "Wen Hui Pao's Bourgeois Direction Should Be Criticized", PEOPLE'S DAILY, July 1, 1957) It also means that they were through and through bourgeois Rightists. If the "Gang of Four" had prevailed, it would not be very long before in our socialist motherland "a national counterrevolutionary restoration would unavoidably emerge, our Marxist-Leninist party would certainly become a revisionist party and a fascist party, and all China would change her color." (Mao Tse-tung, notes on "Seven Fine Reports on Cadre Participation in Labor from Chekiang Province", quoted from the introduction to an article "On Khrushev's Phoney Communism and Its Lessons in World History", PEOPLE'S DAILY, July 14, 1964)

The "Gang of Four" as an anti-party clique had carried out a series of anti-party sinister activities in the scientific and technical circles. Such activities show that they are typical representatives of the bourgeoisie and die-hard capitalist roaders in the act of taking the road of capitalism. The broad workers, cadres and professional personnel in the scientific and technical circles, tempered in the fierce fire of the Great Cultural Revolution, have long hated deeply and resented furiously the "Gang of Four" for their traitorous crimes, and waged resolute struggles by various means against this black gang of traitors. The Party Central Committee headed by Chairman Hua, representing the common will of the millions upon millions of people, with the great spirit and courage of proletarian revolutionaries, adopted wise and resolute measures, smashed at one stroke the anti-party clique of the "Gang of Four", saved the revolution, saved the party, saved the people and also saved our revolutionary scientific and technical enterprise. Our party is truly a great, glorious and correct party. Chairman Hua is truly the successor chosen with boundless ease of mind by Chairman Mao himself. With such a wise leader as

Chairman Hua who faithfully implements Chairman Mao's revolutionary line and various principles and policies of the party, our party will be still more prosperous and thriving, our nation still more flourishing, well off and powerful, and our scientific and technical enterprise also will certainly make fast and vigorous progress. We the scientific and technical workers are jubilant and full of enthusiasm, and will boldly fight the common enemy and forcefully criticize the black gang. "With power to spare we must pursue the tottering foe, and not ape Hsiang Yu, the conqueror seeking idle fame." Our once suppressed socialist activism gathered again the momentum of a landslide, and nobody can stop us now. "The Golden Monkey wrathfully swung his massive cudgel, and the jade-like firmament was cleared of dust." All of us cannot help exclaiming from the bottom of our hearts: Smashing the "Gang of Four", China has a great future; dragging out the four wolves, modernization in four fields goes ahead with great speed. Closely follow Chairman Hua, closely follow the Party Central Committee, exert greater efforts in study, do your work happily, continue to make revolution without stopping, and be assured that prospects of communism are boundlessly bright!

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PRINCIPLES, APPLICATION OF CONTROLLED NUCLEAR FUSION EXAMINED

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[Article by Wei Tseng-ch'uan [5898 1073 3123] of the Institute of Modern Physics, Chinese Academy of Sciences: "On Controlled Nuclear Fusion"]

[Text]I. Foreword

In a class society, any branch of science or technology is a tool of class struggle. "Controlled nuclear fusion" is no exception. The birth of this branch of science is closely tied to the ability of this type of fusion reaction to produce large quantities of neutrons, which can be used to produce plutonium, and to its important military significance. Back at the end of the 1940's the U.S., the USSR, and other nations engaged in work in this area in an atmosphere of extreme secrecy to serve their own military ends. They sought to exploit this branch of science and technology as a servant of politics in their countries. By the 1950's, due to the rapid development of fission piles, a source of neutrons was no longer the difficulty it had been in the early stages, and it had also been learned through experience that achieving controlled nuclear fusion was not as easy as had first been thought. It could still not be done using the already mastered behavior of charged particles in a magnetic field, knowledge of gaseous discharges, and experience with fission piles, and it was necessary to first establish a theoretical and experimental foundation for the development of this branch of science by building up plasma physics, developing new experimental techniques, and gaining a deeper understanding of fundamental plasma behavior. If the goal of reaching the application stage with controlled nuclear fusion were to be sought, there must first be a stage of basic theoretical research. At that time, however, great difficulties were encountered in many areas (such as macroscopic instability) of this research, which forced some nations to partially relax their secrecy requirements and engage in so-called exchange and

cooperation with other nations. Although the multifarious specialized conferences concerning fusion research since the Second Geneva Conference on the Peaceful Utilization of Atomic Energy in 1958 have gradually made public part of the research results in this branch of science, some important achievements remain secret. In 1972 the American and Soviet tyrants signed a so-called agreement for the peaceful utilization of atomic energy which included fusion research. They paid lip service to cooperation while covertly struggling with one another; they strove to be first to create a large-scale device, and stepped up pile research. In their vain attempts at world domination each sought to gain pre-eminence in fusion research. It is evident that the Soviet and American tyrants are colluding with each other and also vying with each other in the realm of science and technology, each seeking to exploit its advanced science and technology to serve its own political ambitions, especially the Soviet revisionists, whose socialist imperialism has been more transparently revealed.

While currently engaging in controlled nuclear fusion research, the Soviet revisionists and American imperialists keep on crying that the goal of their research is "to solve man's energy problems," "to benefit mankind," "for peaceful utilization," and so on. Actually, this is all a smokescreen to hide their previously mentioned political ambitions and military goals, lies which they have fabricated in pursuit of high monopoly profits.

It should be pointed out that due to the ability of the light-nuclei fusion reaction to yield enormous energy, if man can but control this reaction, it can become an important energy source. As with each emergence of a new source of energy in history, utilization of this fusion energy source will exert a positive and promotive effect upon the development of social production. At the same time, if this fusion energy source is to be used, it is also necessary for us to make investigations and breakthroughs in various areas such as theory, technology, engineering, and materials. These investigations and breakthroughs will in turn promote the development of industrial technology. In addition, nuclear fuel resources needed for this energy source are all but inexhaustible, and also inexpensive; but of still greater value is its superiority with regard to environmental protection. Therefore, with class struggle as the key policy, we should "certainly catch up with and surpass the world's advanced levels in the not-too-distant future"*; we must strive to carry on this important and far-reaching scientific research topic in order to consolidate national defense

* Quoted from Chieh-fang-chun Pao, 29 October 1966.

and serve our country's proletarian dictatorship, oppose the tyranny of the two superpowers, destroy the nuclear monopoly and nuclear blackmail of their preposterous attempts to claim world hegemony in the domain of controlled [fusion], support world revolution, and support the revolutionary struggles of the peoples of the Third World.

Prior to the achievement of the controlled fusion reaction, the main task of this work is to verify its "scientific feasibility." Although there has been some progress over the last twenty years, the most prominent research results have been obtained only during the past few years, and the pace of progress has greatly accelerated especially since the 1970's. The most pressing research goal at present remains the problem of heating and binding a high-temperature plasma. Its embodiment in experiments is the study of [means of] satisfying the necessary conditions for the controlled fusion reaction. Henceforth, while studying the heating and binding of high-temperature plasmas, consideration should also be given to corresponding development of the engineering aspect of research necessary for constructing a fusion pile. Despite China's late start with respect to controlled fusion research, with the guidance of Chairman Mao's revolutionary line, with the leadership of the party, with the superiority of the socialist system, and with the efforts of the great workers, technicians, and researchers, we shall nevertheless certainly carry fusion work farther along, just as in the development of other enterprises.

II. Principles of Nuclear Fusion

The basic process of nuclear fusion is to cause a fusion reaction by overcoming the Coulomb repulsion between two light atomic nuclei so that they are transformed into a heavier atomic nucleus and a nucleon (which may be either a proton or a neutron depending on the type of the reaction). The reaction's special characteristic is that its products possess very high energy; that is to say, the nuclear fusion reaction is an energy-yielding reaction. The reactions primarily used in nuclear fusion are:

$$D + D \longrightarrow T + P + 4.0\ \text{MeV},$$
$$D + D \longrightarrow {}^3\text{He} + n + 3.25\ \text{MeV},$$
$$D + T \longrightarrow {}^4\text{He} + n + 17.6\ \text{MeV},$$
$$D + {}^3\text{He} \longrightarrow {}^4\text{He} + P + 18.3\ \text{MeV}.$$

Because the isotope tritium does not exist in nature, the neutrons produced by the D-D reaction above are used to react with lithium (Li) in order to manufacture tritium:

$${}^6\text{Li} + n \longrightarrow {}^4\text{He} + T + 4.8\ \text{MeV},$$
$${}^7\text{Li} + n \longrightarrow {}^4\text{He} + T + n - 2.47\ \text{MeV}.$$

Atomic nuclei carry positive charges, and thus whenever two atomic nuclei approach one another their Coulomb force of mutual repulsion increases, making fusion difficult. If each atomic nucleus participating in the reaction can be placed in a high-temperature state, then on the one hand its average kinetic energy will be increased, overcoming the Coulomb force and increasing the probability of fusion; and on the other hand, the number of instances of possible collision between each nucleus and another nucleus will be increased, thus also increasing the probability that a nuclear reaction will occur in each atomic nucleus. In order to realize nuclear fusion, therefore, it is necessary to place all of the atomic nuclei participating in the reaction in a high-temperature state. The "thermonuclear" in "controlled thermonuclear reaction" refers to atomic nuclei heated to such high temperature; "controlled" means slowing down and artificially controlling the nuclear reaction so that it may reach the goal of utilization (a hydrogen bomb explosion is an artificially produced uncontrolled thermonuclear reaction).

With regard to the nuclear fuel participating in the fusion reaction: whenever a deuterium-tritium gas is heated to a high temperature, the gas molecules are completely ionized into an aggregate of electrons and ions (atomic nuclei); an ionized gas in such a state is called a "plasma" In order for nuclear fusion to be complete and self-sustaining, two fundamental conditions--commonly called the thermonuclear "ignition" criteria --must be satisfied.

1. High Temperature

In order to ensure a balance between thermal power released by the fusion nuclear reaction and power lost due to radiation, the temperature of the ions in the plasma must exceed a certain minimum value, which for a half-and-half mixture of deuterium and tritium is around 50 million degrees (K), and for a deuterium-tritium plasma around 100 million degrees (K) or higher.

2. Maintenance of Thermal Energy in the Plasma for a Sufficient Time

In order to enable the thermonuclear energy produced by the fusion reaction to compensate for the energy required by the plasma and for loss, it is necessary to satisfy the condition $n\tau > A$, where n is the plasma density (cm^{-3}), τ is the binding time (sec) of the plasma, and A is a coefficient related to nuclear fuel composition and energy circulation efficiency. This relationship also indicates that the ratio of the number of nuclei undergoing nuclear reaction (directly proportional to $n^2\tau$) to

the total number of nuclei (directly proportional to n) should be greater than a certain value. This ratio, then, is also the probability for each plasma nucleus to undergo a nuclear reaction within time τ. According to the Lawson Criterion, for a half-and-half mixture of deuterium and tritium, $n\tau > 10^{14}$ sec/cm^3; for deuterium-deuterium, $n\tau > 10^{16}$ sec/cm^3. The so-called Lawson Criterion mentioned above was proposed by the British scientist J. D. Lawson back in 1950; it was erected upon a foundation of energy equilibrium. With regard to the pulsed fusion reaction, if the energy liberated by the reaction is to exceed twice the amount of energy input to the plasma, the relationship which the minimum $n\tau$ value of plasma temperature T and density times binding time should satisfy is determined by this criterion. The common method of representation is to provide a product $n\tau$ of plasma density and binding time for a definite ion temperature (T_i). If the Lawson Criterion is expressed as a curve, the shaded region in Figure 1 is the region which satisfies the D-T Lawson Criterion. The Lawson Criterion is only a prerequisite; if energy output is to be truly realized, the requirements will be even more stringent and the difficulties even greater.

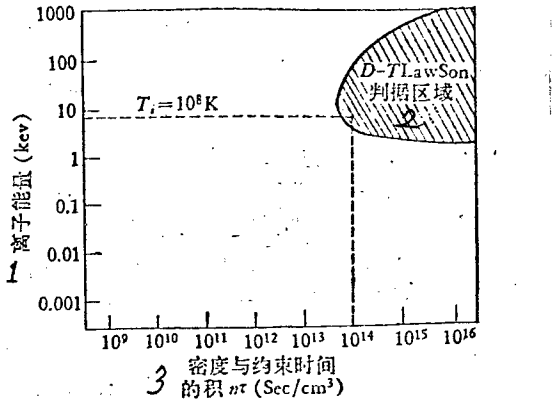

Figure 1. D-T Lawson Criterion Curve

Key:
1. ion energy
2. criterion region
3. product $n\tau$ (sec/cm^3) of density and binding time

Secondly, the Lawson Criterion is also established on the basis that the plasma satisfies Maxwell particle distribution. If it does not satisfy Maxwell particle distribution, then the Lawson Criterion can be broadened somewhat. For instance, for a deuterium neutral particle beam of around 150 keV injected into a tritium target plasma whose electron temperature is 5 keV, $n\tau$ need be only 8-10 x 10^{12} sec/cm^3; in other words, there is an order-of-magnitude decrease from the original "ignition" requirements.

It should be pointed out that the above-mentioned ignition requirements and the Lawson Criterion are applicable with respect to "clean" impurity-free fuel systems. If the slightest trace of high Z (atomic number) impurity is present, the ignition conditions and the Lawson Criterion will be affected. This is because the existence of impurities in the high-temperature plasma will cause a great increase in the bremsstrahlung radiation power produced by electron-ion and electron-electron collisions, which causes a distinct reduction of plasma temperature. It has now been calculated that when the concentration of Mo impurity $> 0.8\%$ or the concentration of W $\approx 0.2\%$ (Mo and W are generally structural materials in reactors), "ignition" is impossible no matter how high the temperature. A simple analogy has therefore been made: after a pin-point speck of metal is vaporized, it is sufficient to extinguish a deuterium plasma the size of several railroad boxcars.

For this reason, if ignition is to be achieved, it will be necessary to fundamentally raise the plasma parameters (temperature, density, and binding time) while controlling or eliminating impurities. These problems are research topics for which solutions are currently being sought; their solution reflects even more a great step forward in controlled nuclear fusion research, be it in physics or engineering. The achievement of "ignition" will be deemed a new milestone in controlled nuclear fusion research. It is necessary, however, to point out that the ignition device will not necessarily be the optimal form for future reactors; it is a fairly long way from the achievement of "ignition" to the building of a reactor, and there will be more than a few problems whose investigation and solution will require an eclectic approach on our part.

III. Forming, Heating, and Binding of High-Temperature Plasma

The main questions at present in high-temperature plasma research are heating and binding: how to further heat the plasma to a high temperature while simultaneously maintaining it for a definite and stable time. Below we shall simply describe the methods of forming and heating plasma, as well as the binding of plasma.

1. Forming and Heating of Plasma

Due to the continual development of science and technology, man has gradually gained a grasp of the methods and techniques of plasma formation. Based on the progress of modern technology, the high-temperature plasma necessary for building a fusion pile is considered entirely feasible. As for the aspect of heating, many methods currently exist, and a combination of various methods can be chosen according to the type of plasma-binding device.

In ohmic heating, the simplest method, a large electric current (more than several hundred kA) flows through the plasma, which is heated by utilizing the ohmic loss of electrical resistance of the plasma. The drawback of this method lies in the sharp drop in the electrical resistance of the plasma with temperature increase: when the temperature of the plasma reaches about 10 million degrees (K), its electrical resistance value is about the same as that of copper; that is to say, after the plasma reaches a high temperature, heating efficiency becomes very low. However, due to the appearance of resistance anomalies, which are regarded by some as being triggered through certain microscopic instabilities, it may be possible to achieve thermonuclear temperatures by relying solely upon ohmic heating.

The fast neutral particle injection heating method is to accelerate the atoms serving as nuclear fusion fuel in a booster to an energy of several ten to several hundred keV and then inject this energetic particle beam into the plasma-binding device. The particles captured by the binding device are heated by colliding to and fro, whereupon they become a high-temperature plasma. In May 1974 the U.S. Atomic Energy Commission announced that the ignition requirements of a device could be reduced by an order of magnitude with neutral beam injection heating. If this statement is accurate and reliable, then the day when "ignition" is achieved may have been brought a step closer. Thus over the past few years quite a few devices have experimented with this method of heating, a method more generally considered to hold possible promise, and the building of neutral beam injectors has developed rapidly. According to reports, the U.S. at Livermore has already installed on the "2X-II" magnetic mirror device 12 enormous neutral beam injectors, each of which injects 50-A, 20-keV, 10-ms pulses of neutral deuterium atoms into the plasma reaction chamber; it is said that this new type of injection system will raise the fuel temperature to ten times the temperatures currently produced, to one or two hundred million degrees (^{o}C).

In addition, the plasma particles bound in a magnetic field spin around the lines of magnetic force. If the frequency of this spin is exactly in phase with a high frequency externally applied to the plasma, the plasma particles will resonate with this high frequency, and by obtaining the energy of such high-frequency waves, the particles will be heated to a high temperature. The condition in which plasma electron resonance is caused is called electron spin-resonance heating, which will employ microwaves on the order of 10^{9} hertz; the condition in which plasma resonance is caused is called ion spin-resonance heating, which will employ medium waves on the order of 10^{6} hertz.

In addition to these, there is also the application of thermodynamic principles, the method of heating by adiabatic compression of the plasma. There are also turbulence heating, high-frequency heating, fast magnetic acoustic-wave heating, shock-wave heating, mixed resonance heating and other methods, as well as the method whose rapid development has begun most recently, the method of obtaining a high-temperature plasma by bombarding solid fuel (deuterium pellets or tritium pellets) with a high-power (10 GW to 100 GW, 1 GW = 10^6 kW) pulsed laser.

2. Plasma Binding

If a high-temperature plasma is placed directly in a metal vessel, the high-temperature plasma will come into contact with the vessel walls, resulting in the melting of the vessel walls and the simultaneous cooling of the plasma. Thus, generally speaking, a magnetic field is used to surround the high-temperature plasma. Using the pressure of a very strong magnetic field causes the high-temperature plasma to be restricted to the center of the vessel, and it does not come in contact with the metal vessel walls. But under these conditions, the metal vessel walls will not be heated by radiation from the high-temperature plasma, and for a fusion reactor this type of heating can reach as high as around 10^3 degrees (K). To bind a plasma in a magnetic field forever is theoretically impossible; moreover, permanent binding is not necessary for a fusion pile. However, as was explained in the preceding section, a minimum necessary binding time is required; this is determined by the type of reactor and the plasma state. For a stable deuterium-tritium pile, the binding time is around one second; for the pulsed pile, the binding time can be somewhat shorter.

Everyone knows that it is generally easier for plasma particles to move along lines of magnetic force, and that movement across lines of magnetic force is more difficult. If electric currents flow in the same direction through two parallel coils (as in Figure 2), a magnetic field which increases in strength from the middle toward the two ends will be formed. Under these conditions, when the particles move along the lines of magnetic force, because the magnetic field is stronger near the coils at the two ends, they are bound back into the central portion. This is the principle of binding with the early simple open-end magnetic mirror. However, it has been found that the intensity of a magnetic field with this type of structure is weakened radially, and thus the plasma is very rapidly lost due to movement across the lines of magnetic force. Subsequent development led to the concept of the magnetic well, that is, the extremely small B (magnetic field strength) principle, where a stable field is superposed on the original mirror field to form

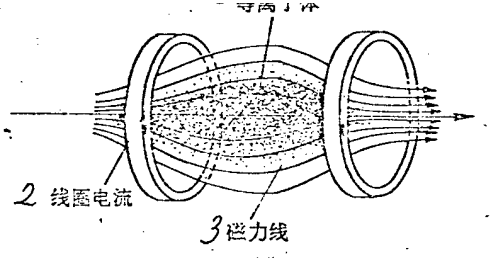

Figure 2. Diagram of Open-end Magnetic Mirror

Key:
1. plasma
2. coil current
3. lines of magnetic force

a field shape which is weakest in the middle and which increases in strength in all directions. Because of the energy relationship, the plasma which is captured at the bottom of the magnetic well cannot move en masse in any direction. This type of configuration causes the binding time to be increased over the original [time] by two orders of magnitude. On the basis of magnetic well structure, various types of flexible and variable magnetic field configurations are now being studied: positive-negative coils, baseball coils, quadri-, hexa-, and octapolar fields, disc magnetic mirrors, slit convergence, and so on.

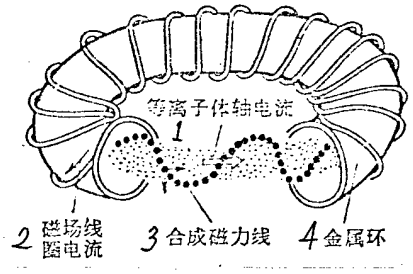

Figure 3. Diagram of Closed-type (Ring-shaped) Bound Plasma

Key:
1. axial current of plasma
2. magnetic field coil current
3. formation of lines of magnetic force
4. metal ring

Another kind of magnetic field is formed when an electric current flows through a closed toroidal helical coil (Figure 3).

Under these conditions, the particles move along the closed toroidal lines of magnetic force and cannot escape. The plasma is bound within a ring-shaped magnetic field. Although the plasma bound within the confines of the magnetic field is spinning around the lines of magnetic force, motion across the lines of magnetic force is difficult. But once collision between plasma particles in motion occurs, in that instant the particles will change to their original orbits and advance transversely across the lines of magnetic force; such a plasma will gradually diffuse and leak outward, which phenomenon is referred to as the "classical diffusion" of plasma. The speed of diffusion is proportional $[T^{-1/2}B^{-2}]$ to plasma temperature T and magnetic field strength B. In addition, due to the presence of various instabilities in the plasma, another type of "fast diffusion" is produced; this is the so-called "Bohm diffusion", which is due to the production of anomalous electrical fields by various factors while the charged particles of the plasma move in the magnetic field, which cause the charged particles to advance transversely across the lines of magnetic force. The speed of Bohm diffusion is proportional to $[T\ B^{-1}]$. The current utilization of magnetic shearing to suppress the fast diffusion of plasma in the ring system has already achieved obvious accomplishments. However, judging from results observed with a number of experimental devices, classical diffusion is still the major loss mechanism, and thus except for the fact that increasing the magnetic field strength can simultaneously reduce the speeds of these two kinds of diffusion, raising the plasma temperature will seemingly speed up the rate of Bohm diffusion, yet it has an even greater effect with regard to reducing the rate of classical diffusion which constitutes the major loss. It is reported that the adoption of the neutral beam injection method in the "2X-II" device mentioned above not only raises the plasma temperature but will also hopefully quadruple binding time. Further increasing the magnetic field strength and raising the plasma temperature are thus extremely essential with respect to better binding the plasma and achieving controlled nuclear fusion.

IV. Current Status and Trends in Controlled Nuclear Fusion Research

Controlled nuclear fusion research, which was begun in the late 1940's in the U.S., the USSR, and England, has now spread to 17 countries and Euratom. During this timespan of more than 20 years, controlled [fusion] research has traveled a winding road, from the blind optimism of the early 1950's which turned to the pessimism and conservatism of the later 1950's, from the revival of guarded optimism of the late 1960's which has carried through to the beginning of the 1970's and up to the present, when feelings of optimism have risen even further. During the past 20

or more years, according to incomplete statistics, the nations of the world have spent a total of $U.S. 15-20 billion on plasma physics and controlled nuclear fusion research and have invested considerable manpower and materiel, yet no great progress has been made, and it is still a considerable distance to the goal of ignition. Although important progress has now been achieved in this realm, it is to be hoped that the major emphasis will soon shift from the fundamental research stage to the area of engineering research and nuclear power. However, many key questions have not yet been completely resolved, and an eclectic research approach remains necessary. As for bringing controlled nuclear fusion to the application stage, it appears that at least another 20 or more years of hard toil will have to be gone through. We should learn a lesson from the experiences of this stage of the history of development of controlled [fusion]: we cannot run blindly along with erroneous foreign inclinations. It is necessary to guard against the adoption of erroneous methods of blind optimism or persistent conservatism.

Nuclear fusion research (including the investigation of new means) has progressed rapidly throughout the world since the 1970's, directions have been made even clearer, the main points have begun to take shape, and efforts have gradually been concentrated. Development over the past few years has been faster than previously with regard to the three main methods of magnetic binding: low β (β = plasma pressure/magnetic field pressure) rings (tokamak, low β stellarator, etc.), high β ($\beta \geq 0.1$) rings (high β stellarator, helical pinching, belt pinching, etc.), and magnetic mirrors. This is especially true of the tokamak device: after the construction of nearly 20 new devices, excellent results have been obtained with all, and it has become a main point in the research of various nations.

Laser fusion, which appeared at the beginning of the 1960's, has also advanced rapidly. The building of a high-energy short-pulse multipath laser was hastened after the U.S. adopted a partial relaxation of secrecy in 1971, and the laser's constriction efficacy, which causes the neutron yield of each pulse to greatly increase, has already been observed experimentally. Numerous nations have consequently placed more emphasis on this new approach, and regard it as a promising approach in controlled nuclear fusion research.

New results have also recently been obtained in the study of high-flux relativistic electron beam fusion, and plasma focusing is also being investigated.

The "tokamak" utilizes a principle similar to that of the ordinary transformer: by pulsing a large current through the primary

coil of a transformer, electrical discharge is produced in a ring-shaped vessel equivalent to the secondary coil; this discharge current can reach several hundred kA, and the plasma formed in the discharge is heated by this discharge current. Another aspect is that the plasma is bound by relying on the strong magnetic field produced by the coils wound around the ring-shaped vessel (see Figure 4). Due to the inherent characteristics of the basic tokamak configuration, work with it is

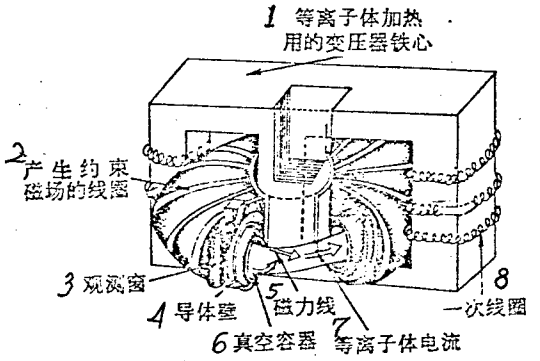

Figure 4. **Diagram of Tokamak Device**

Key:

1. iron core of transformer used for plasma heating
2. coil which produces binding magnetic field
3. observation port
4. conductor wall
5. lines of magnetic force
6. vacuum vessel
7. plasma current
8. one coil

comparatively more mature and there is greater accord between theory and experiment. Because its level is nearest the Lawson Criterion, it is in a leading position, and so the other nations with the exception of the Federal Republic of Germany have classed it as a major approach for priority development. The Federal Republic of Germany, the Soviet Union, and England are still stressing stellarator work, whereas the U.S. halted work in this area in 1969. The U.S. has classed development of the high β ring device (Syllac) as second priority, and the Federal Republic of Germany, Japan, and other nations are also stressing work in this area; but the Soviet Union and France are not emphasizing the study of the high β ring device. Western Europe and Japan are not involved at all in magnetic mirror devices, while the U.S. has ranked these third in priority (the 2X-II magnetic mirror device), and the Soviet Union and other nations are also beginning work in this area. Generally speaking, all nations are giving more emphasis to laser fusion research work.

In a realm of advanced scientific research such as controlled nuclear fusion which is being investigated and which is developing rapidly, defining the correct technological line is of the utmost importance. Acting in accordance with China's concrete realities and following the teachings of Chairman Mao, and with the guidance of the fundamental party line, we must be independent, autonomous, and self-reliant, work diligently despite hardship, strive to make the country strong, and lay down the correct line for achieving greater, faster, and more economical development in our country's controlled [fusion] enterprise.

It seems that the present trend in the world's nuclear fusion research is toward the goal of building a "critical pile core plasma" (a plasma which satisfies the Lawson Criterion) around 1980. After this decade, positive consideration will be given to the constructing and testing of experimental power piles, and achieving the level of building a useable pile is scheduled for the decade from 1990 to 2000.

Along with the study of pile core plasmas, consideration should henceforth be given to rapidly expanding the conducting of research in the area of fusion pile technology, especially including fundamental irradiation damage and material strength studies of the materials required to build a reactor, and emphasis should be given to developing tritium production and treatment technology, heat-removal technology, and such techniques as large super-conducting magnets for producing intense magnetic fields.

V. Applications of Controlled Nuclear Fusion

Normally there are two methods of utilizing nuclear energy. First is the widely known utilization of the energy released in fission by heavy atomic nuclei (such as U, Pu), which has now reached the actual application stage; second is the utilization of the tremendous energy obtained from thermal nuclei undergoing a fusion reaction, the subject of the present discussion, which is at present still at the research and development stage. Utilizing the nuclear energy produced by controlled nuclear fusion as a source of power is extremely advantageous.

1. Abundance of Fuel Resources

Deuterium, the primary fuel of the fusion pile, can be extracted from water. Twenty-five liters of water contains around one gram of deuterium. The energy produced when this one gram of deuterium is completely "burned" in a nuclear fusion pile is around 10^5 kilowatt-hours; and if all the deuterium in the seas of the earth were used in nuclear fusion, it is estimated that

3×10^{24} kilowatt-hours of energy could be produced. Thus fuel resources for a nuclear fusion reactor are seemingly "inexhaustible."

2. High Safety

When a fusion reactor is in operation, the fuel added to the core is an extremely minute quantity (gaseous fuel around only 10^{-4} atmospheres is injected within the core) of deuterium or a mixture of deuterium and tritium, and therefore the danger from a major malfunction of the fusion pile is very small, and there is a high degree of safety. Moreover, the fusion reactor also possesses very great superiority in the area of environmental protection safety. First, because it is not the same as electrical power generating facilities employing such previously used fuels as coal, oil, and natural gas, there is no need for concern over atmospheric pollution by CO_2, CO, SO_3, SO_2, NO_2 or NO; second, because of its high energy conversion efficiency and minimal waste heat, the general threat posed by waste heat is also small--whence the appellation "clean energy source." Thus it is permissible to construct power stations directly in the vicinity of cities, thereby shortening power transmission networks, and the cities can utilize the heated waste water for ordinary and industrial uses, which is very advantageous economically.

3. No Recurrent Problem of Treating Radioactive Wastes

The problem of treating the radioactive wastes which are present in fuel "burning" when a fission reactor is used to generate electricity as a source of energy is a very important research topic. With the fusion reactor, however, in actuality the problem of regularly disposing of radioactive waste does not exist. Just as was described in the preceding, although the radioactive product tritium is produced in the D-D fusion reaction, it can be re-utilized as fuel and therefore does not become waste. Of course, the problem of tritium leakage must still be heeded; yet based on the current development of nuclear fission technology, this problem is considered solvable. In addition, there exists the problem of the activation of the structural materials of the reactor by the neutrons produced in the fusion reaction. Comparing reactors of similar power, however, the extent of such activation in a fusion pile is around 100 times less than in a fission pile. Furthermore, the substances subject to activation are mainly solids and are therefore comparatively easy to treat.

4. Cheap Cost of Energy

Estimates of the cost of generating electric power by nuclear fusion have been made, according to which the fuel cost averages 0.007 fen People's Currency per kilowatt-hour for a D-T reactor with a power output of 2.1 million kilowatts. Including the expenses of constructing the power plant and loss, the total cost of power generation is estimated as averaging 0.4 fen People's Currency per kilowatt-hour. It is evident that fuel cost comprises but a very small fraction of the total power generation cost, and the power generation cost will continue to decrease along with the lowering of construction expenses and the reduction of loss.

VI. Conclusion

From the above it can be seen that the controlled nuclear fusion reaction is theoretically attainable and can be reached technologically through diligent effort. It is also advantageous in terms of application, and so during the past few years many of the world's nations have been working hard [toward this goal]. Since last year, however, some nations have slowed the pace of planning and development. This is the result of the capitalist world's encountering the most severe economic crisis since the war.

We are a socialist nation, and the planning and development of all work is viewed in the context of the proletarian enterprise as a whole and in consideration of long-range benefit to the state as well as current economic and technological levels. In accordance with the requirements of the international class struggle and the need to consolidate the dictatorship of the proletariat, and with currently feasible conditions, we should positively, appropriately, and effectively develop this work, be resolved to pulverize the destructiveness of the campaign of rightist restoration, strive to use Marxism-Leninism and the ideology of Mao Tse-tung to occupy this new realm of science and technology, and make new contributions to China's socialist revolution and construction and to mankind!

BIBLIOGRAPHY

1. Tung Li [Power], 23-126 (1973).

2. 140th Meeting of the American Association for the Advancement of Science, Fusion Power Research and Development: The Scene Today, Feb. (1974).

3. Nucl. Fusion, 14-2 (1974).

4. Lu Ho-fu [4151 7729 4811], et al., ed., Shou-k'ung Je-ho Fan-ying [The Controlled Thermonuclear Reaction].

5. Phys. Review Letters, 32-12 (1974).

6. ORNL-4793 (1971), 43-45.

7. Atomnaya Dnerliya, 33-1 (1972), 599-600.

8. Nucl. Fusion, 14-1 (1974).

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CSO: 8111/1225-A

COMPOSITION, OPERATION OF ROBOTS BECOMING MORE SOPHISTICATED

Peking K'O-HSUEH SHIH-YEN [Scientific Experiment] in Chinese No 3, Mar 77 pp 18-20

[Article by I Ch'ing [0122 3237]: "The Robot: Illusion Becoming Reality"]

[Text] Originally, the "robot" was merely a character in science fiction stories. With the development of science and technology, it has gradually moved out of the world of fantasy into the world of reality. The "robot" is no longer mysterious or wondrous as some people think. For it is actually a kind of automatic machine which is designed and built by man to follow and obey his orders and perform specific useful tasks for him.

"Robot" Needed in Science and Production

The "robot" is not made just for the sake of creating something new or sensational. It is made to solve all kinds of practical problems that occur in the development of production, science and technology, and help achieve higher level of mechanization and automation. Just think of it: Wouldn't it be safer and easier if the "robot" instead of man was sent to explore the depths of the ocean and outer space? When an atomic reactor breaks down, wouldn't it be possible to eliminate the danger of exposing man to atomic radiation by having the "robot" repair it? Would it not be better to keep man from risking the hazards of fire-fighting, mining and underground water pipe construction work by having the "robot" do the work? If the "robot" is used to work in dusty, noisy, poisonous, high temperature, low temperature, high pressure or vacuum working environments, we could greatly reduce occupational diseases that are harmful to the human body. Even more important, if the "robot" can be made to perform the work of man, we can liberate a great number of the laboring force, and thus greatly raise productivity. By employing the "robot" to do monotonous, repetitious job routines and work that easily wear out nerves, we can maintain better uniformity of work and cut down human or equipment accidents.

Combination of Various Scientific and Technological Achievements

The present stage of science and technology developments has become the material basis for production of "robots." In designing and application of the "robot's" hands, wrists, arms and body, we have accumulated a tremendous amount of experiences from the use of extended arm in plastic surgery as well as mechanical hands and controllers currently used in industry. The hydraulic, pneumatic, electric and mechanical gearing systems we already have are equivalent to human muscles and can convey movement and energy; the techniques in television, electroacoustics and all kinds of instruments can be used to simulate man's sense of sight, hearing, touch and other sensory organs; the various kinds of automatic components and electronic computers can be used to achieve some functions of the human brain. Also with the development and application of the science of life models and artificial intelligence, it is becoming increasingly possible to create a real "robot."

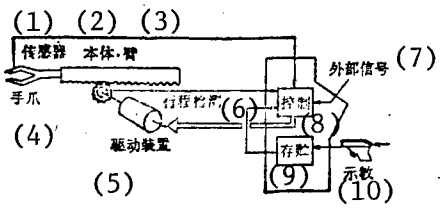
Though the history of "robots" goes back more than 10 years, the so-called "intelligent robot" which has "sensory" capabilities is still in the experimental stage. The type of "robots" currently used in industry can only perform such simple functions as loading and unloading things, transporting, welding, jet-painting, etc., and are thus called the first generation "robot" or general purpose mechanical hand. Second and third generation "robots" may be able to automatically recognize pictures and objects, adapt themselves to different environments by selecting or editing programs on their own, and may even be able to communicate with man through languages. But these may not be achieved within a short period of time.

Although the first generation "robot" is comparatively simple, it is still one step forward from the original mechanical hand (also known as the special purpose mechanical hand or accessory mechanical hand) and controller. The mechanical hand is an accessory device to an automatic machine tool or automatic object conveyor. It is installed in a fixed position and programmed to work according to a certain operational procedure. In contrast to the mechanical hand, the "robot" can move about and change operational procedures. It has good flexibility and adaptability. Although the controller can help extend and enlarge the action range of the human hand, which is quite useful in forming, handling radioactive materials and preparing explosive articles, the controller, nevertheless, is still dependent on the action of the human hand. Unlike the controller, after it programmed to do a specific task, the "robot" can work on its own. Therefore, it is more efficient. In the following sections, we will give the reader a rough idea of the various integral parts of the "robot," based on the first generation "robot."

Imitation of the Human Body

Some "robots" at present look like human beings. But most of them do not. The typical "robot" should have a main frame (as the human body), arms, hands and control system (brain), sensory components (sensory organs), and, of course, a drive mechanism equivalent to the human muscle (see Figure 1).

Figure 1



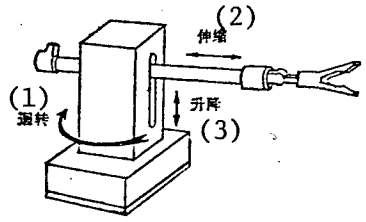
Key:

1. Sensory pick-up device
2. Main frame
3. Arm
4. Hand
5. Drive
6. Distance gauge
7. External signal
8. Control
9. Storage
10. Instruction

The distance range that the "robot's" hand can reach depends on the movement of body and arm. There are four basic types of "robots" currently used in industry which are categorized according to different kinds of body and arms: cylindrical coordination type, polar coordination type, rectangular coordination type and multi-articulation type.

The cylindrical coordination type is like the vertical pillar and rotary arm of the radial drilling machine. Its main body can turn around. Its arm can ascend or descend along the body as well as extend or retract (see Figure 2)

Figure 2



Key:

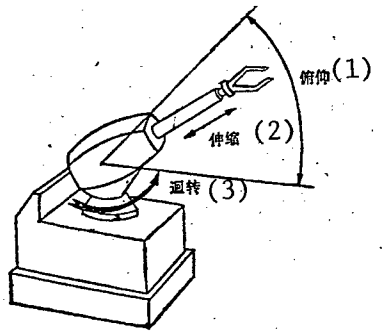
1. Rotary movement
2. Horizontal movement (extend/retract)
3. Vertical movement (ascend/descend)

The action range of the hand which is installed at the fore end of the arm is cylindrical. If the main body cannot rotate in a complete circle, the action range of the hand is then partly cylindrical.

The polar coordination "robot" looks like the turret of a tank. The body can turn around, arms can incline or decline, extend or retract (see Figure 3). The hand action range is partly spherical and can pick up things from the ground.

The rectangular coordination "robot" works like a bridge crane. Its body and arm move in straight lines along three perpendicular directions, giving the hand a cubical action range.

Figure 3



Key:

1. Inclination
2. Extend/retract
3. Rotate

The multi-articulation "robot" moves on several rotary articulations like a digging-and-loading machine. Its body can turn around. Its arms have several articulation hinges. The hands also have a partly spherical action range, but can do more kinds of movements than polar coordination "robots," and can get around obstacles.

Hands That Can Adjust to Characteristics of Objects

There are all kinds of "robot" hands; and choosing the right kind for a specific job depends on the shape, size, weight, hardness, temperature and mechanical characteristics of the object. Today, the hands of industrial "robots" fall into three main categories: mechanical types, vacuum types and electromagnetic types.

The mechanical hand opens and closes by the mechanical movements of hinges, rods, springs, gears, racks, lead screws, oil cylinders and gas cylinders.

The vacuum hand picks up objects with a suction pump or by producing a negative pressure from an air stream injected into a suction tube. The objects must have flat, smooth surfaces with no holes. Depending on the weight and size of objects to be picked up, one or more suction tubes can be used.

The electromagnetic hand works on the same principle as the electromagnetic crane. As it uses the magnetic force to attract objects, it can pick up objects of irregular shape, objects that are difficult for mechanical or vacuum type hands to pick up, and scattered tiny objects. But this kind of hand can cause objects to be magnetized, which should be taken into consideration.

Quite a number of "robots" have wrists that can turn and swing.

Various Kinds of Drive Systems

The motion of the "robot's"body, arms, wrists and hands comes from the kinetic force conveyed through the drive system, which fall into four categories: hydraulic, pneumatic, electric and mechanical.

The advantages of a hydraulic system are: high pressure, small body, strong force and smooth movements. Its pressure flow can be regulated. It has continuous speed control and simple power braking system. Its hydraulic pressure oil is lubricative and anti-corrosive. The disadvantages of such a system are: the tubular circuit is rather complicated and its working characteristics are easily affected by oil leaks or change in oil viscosity due to temperature changes. Also it requires pumps and other installations, which is quite costly. A hydraulic drive system is used in most industrial "robots" today.

The advantage of the pneumatic system lies in the fact that it is very convenient to use. Generally, 4-8 atmospheric pressure of compressed air is required. This is available from ordinary factory-made compressed air sources. The components are easy to construct and maintain. Moreover, it moves faster. But this kind of "robot" produces low output force, and comes in cumbersome sizes. Also, due to the great compressibility of air, it is difficult to make accurate adjustments in speed and position. Pneumatic "robots" are widely found in industry.

The advantages of the electromagnetic system is the convenience of electric power. Maintenance is easier. It has big power output, and uniform dynamic force is exerted in working and control installations. But it has weak points as well: it has to have moderators with high deceleration rates. In order to move along a straight line, it also needs lead screw nuts or linear electric motors. To turn its body around, it uses electric motors and moderators or speed-control motors. There are relatively few electric powered "robots" today.

The mechanical drive system has high reliability and simple structure. But it is difficult to change its program.

Flexible Control System

The control system is the brain of the "robot." Its chief function is to receive (or memorize or store) the operational programs assigned to the "robot" by man, and to control its body, arms and hands according to the program, which includes the order, position, time, speed, acceleration, etc., of each movement. In "robots" which have all sorts of pick-ups, the control system continuously receives various kinds of signals from the pick-ups, and "assesses" the situation so that it can respond correctly to the situation.

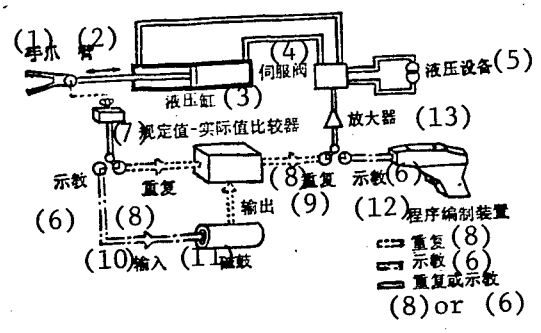
The most commonly used control system in industrial robots is the matrix switch board. Next in common use is the convex wheel drum.

The matrix switch board is criss-crossed with conductors vertically and horizontally. The conductors cross each other in space but are not connected to each other at those cross points which do not have plugs. All horizontal rows are connected to the execution relays of the various movement axis of the body, arms and hands. The vertical columns form operational steps 1, 2, 3, 4, ..., and are electrified in step order. To start a series of movements, the conductors are plugged together at selected cross-points in the order of operational instructions (i.e., the order of plugging). By changing the order of plugging, we can change the "robot's" program, which is an effective way of control.

The principle of the convex wheel drum system is similar to that of the matrix switch board. Each rotary drum has a number of convex wheels, and each wheel is connected to a motion axis. The drum spins at a constant speed, while the wheels initiate the various motion axes in the order of operation procedures. Upon completion of a circle, the drum completes an operational cycle. The operation procedure is changed by adjusting the shape and angle of each convex wheel on the drum.

To perform such tasks as welding and jet-painting, a constant control over the movement path is maintained. For this purpose, a unique kind of "robot" that can be programmed through "demonstration" is employed: first man teaches the "robot" all the movements by demonstrating with hand or control rod. The "robot" memorizes each and every instruction in the right order and stores them in its magnetic tape or magnetic drum. Afterwards, it can reproduce the same movements (see Figure 4).

Figure 4



Key:

1. Hand
2. Arm
3. Hydraulic pressure cylinder
4. Servo valve
5. Hydraulic pressure unit
6. Instruction
7. Standard value-actual value comparison device
8. Repeat (reproduce)
9. Output
10. Input
11. Magnetic drum
12. Program editing equipment
13. Amplifier

Some sophisticated types of "robots" employ digital control units or electronic computer control units. Many of these "robots" have all kinds of pick-up units to sense changes in external conditions.

Developing Sensory Organs

Some jobs require "robots" with sensory organs, especially touch and visual senses to handle objects of special characteristics or complicated tasks.

For instance, to grasp glass or porcelain objects with its hands, the "robot" must use the right amount of force. Otherwise, it will either damage or drop the articles. But how can the grasp force be controlled? The "robot" hands must be equipped with touch sensory organs to feel the objects. One clever design for this purpose is the sliding pick-up sensor which is installed in the hand. In grasping objects, if the sensor slides, a signal is transmitted to the control system which orders the hand to use more force. If the sliding continues, the grasp force increases. This way, the grasp force is enhanced to the required level through the continuous flow of signals from the sliding pick-up sensor. There are all sorts of "robot" sensors today: the spring type, variable plate resistor type, variable carbon grain resistor type, voltage component type and micro switch set type.

To recognize objects or diagrams, the "robot" must have "visual sense organs." The current type of "robot eyes" are mostly TV cameras. The camera eye view is divided into many tiny units called image dots. Through continuous scanning, the brightness signal of each dot is passed on to the electronic computer which judges and decides which action to take appropriate to the specific work requirements.

The hearing type of "robot" can pick up human voice signals, which simplifies communication between man and machine. Microphones can serve the purpose of the "robot's" ears. The sense of smell can help the "robot" determine the presence of any dangerous gases in special working environments, thus ensuring safety. The "nose" of the "robot" can be made out of all sorts of gas analysis instruments.

At present, the "robot's" various sensory organs are still very much in the experimental stage. With the wider application of "robots," the sensory organs will be further developed.

9119
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MODEL XB-J-I LASER COMMUNICATOR

Peking JINMIN CHUGOKU in Japanese May 77 p 60

[Article by Ma Shou-ts'en (7456 1108 1478)]

[Text] In laser communicators, there is the single-channel type and the multi-channel type. The XB-J-I laser communicator, which is being displayed in the heavy industry section of the current PRC Exhibition, belongs to the former type.

The use of laser in communication is a modern, new method. This communication method uses the laser beam, which is invisible to the naked eye and is highly directional, as a signal carrier wave. Since this wave travels in a fixed direction, it has an excellent security feature. The laser beam is not affected by other electrical waves in the atmosphere and the transmitting sound as well as the receiving sound are exceptionally clear.

Therefore, in preventing jamming, it is incomparably better than the conventional radio communication.

This laser communicator, which utilizes gallium-arsenide diodes, uses light signal as the carrier wave and optical transmitting lens to set the direction. As power sources, both alternating and direct currents can be used.

The communication range is 20 km but if this instrument is used as a repeater, the communication range can be lengthened.

The XB-J-I laser communicator was researched and manufactured at the wireless factory in Ch'ang-Ch'un City, Kirin Province. During the research and manufacturing stages, factory laborers and staff employees strictly observed the operational procedure calling for the "three union" of the research department, production department and utilization department, and the "three union" of laborers, cadres and technicians.

Furthermore, great efforts were expended to raise the reliability of this laser communicator and to enable dependable communication of good quality under any weather condition.

They climbed mountains and crossed rivers and repeated tests outdoors for a long period.

As the result of such tests and constant improvements they built the XB-J-I laser communicator which can carry on normal communication under weather conditions of any and all kinds, including sandstorms, rain, fog, lightning, etc.

9134
CSO: 5500

METAL DETECTION TECHNIQUES OUTLINED

Peking K'O-HSUEH SHIH-YEN [SCIENTIFIC EXPERIMENT] in Chinese No 2, 1977 pp 4-5

[Article by Chang K'ai-hsun [1728 7030 6676]: "Metal Detection"]

[Text] What we are talking about here is not looking for metal ore deposits but how to detect metal objects that cannot be seen. There are many ways to detect metal. You can detect it by its absorption of X-rays or by its reflection of ultrasonic waves. Even more common is to detect it by electromagnetic waves, taking advantage of metal's excellent electric conductivity. This method can help men accurately locate underground pipelines and electric cables, find equipment and parts lost underwater, and remove metal objects mixed up in raw materials. It can also help archeological workers find ancient metal cultural objects buried underground.

This technique was developed in the 40's. At first it was used to remove land mines. Later it was used more to make automatic detonating devices for artillery shells in proximity to metal targets. With the growth of industrial production and radio technology, the applications of this detection technique expanded, the detectors became more refined and sensitive, and the accuracy also became higher.

How can radio waves detect metal? This must be answered from the interaction of radio waves with metal. We know that metal objects produce an induced current in an alternating magnetic field. The flow of the electric current strongly resembles a whirlpool in water and it is usually called an eddy current. An eddy current in a metal performs three functions.

1. Since metal has electric resistance, the eddy current causes the metal to heat up, consuming energy from the electromagnetic field, that is, the eddy current converts some of the energy of the electromagnetic field into thermal energy in the metal.

2. If the alternating magnetic field is produced by a coil, the magnetic field produced by the eddy current reduces the inductance of the coil.

3. The eddy current itself excites an alternating electromagnetic field in space. A metal that produces an eddy current is then a new source of electromagnetic wave radiation and at a certain location, you can receive electromagnetic waves radiated by it.

A high-frequency oscillator is used to produce an alternating electromagnetic current in a certain region in space. If a metal object is within the range of the alternating electromagnetic field, it will be marked by an eddy current which gives rise to the three physical processes mentioned above, causes an attenuation in the original electromagnetic field, brings about a frequency change in the electromagnetic waves, and alters the spatial distribution in the electromagnetic field. You can find metal objects on the basis of these variations in the electromagnetic field.

Almost all metal detectors are based on these principles. For different purposes of detection, the structure and performance of the instruments are different. Their principles and applications are explained in four examples below.

Detecting Underground Pipelines

When you are engaged in capital construction projects, you must determine accurately if there are buried pipelines or cables, otherwise you may damage the original facilities or even cause a serious electrical accident. Using a metal detector may greatly raise the work efficiency.

A coil is attached to each end of an insulated rod perpendicular to the ground. The one closest to the ground is called the search coil. It is parallel to the ground and it radiates a high-frequency electromagnetic wave. The one farthest from the ground is the receiving coil. It is perpendicular to the ground. Since both coils are coaxial but perpendicular to each other, the alternating magnetic flux produced by the search coil cannot penetrate the receiving coil and so the receiving coil cannot receive the high-frequency signal. If there is a metal pipeline or cable underground, it will produce an eddy current under the action of the alternating magnetic field produced by the search coil. Part of the alternating magnetic flux produced by the eddy current will penetrate the receiving coil and induce an electric signal. If the search coil produces an audio-frequency-modulated high-frequency signal, the signal induced by the receiving coil will also be a modulated signal of similar wave shape and same frequency. After it is detected and amplified, you can tell if there is a metal object under the rod by the deflection of the current indicator needle or the beep of the loudspeaker. It is easy to determine the location and direction of a pipeline.

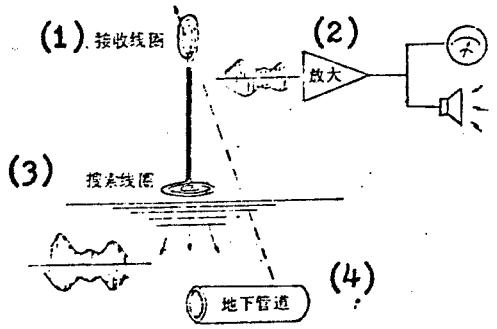

Figure 1. Diagram of Detecting Underground Pipelines

Key:

1. Receiving coil
2. Amplifier
3. Search coil
4. Underground pipeline

Salvaging Sunken Equipment

Sometimes you have to salvage metal objects such as iron anchors, electrical equipment, or ships' hulls sunk at the bottom of a river, lake or sea. When the area of the search is wide or the conditions underwater are poor, metal detectors can be a big help. Although water has a certain electric conductivity, it is far from that of metal. Still, you can use the detection principles of an eddy current to find metal underwater.

If a sealed high-frequency oscillator is put in the water, the search coil radiates an electromagnetic wave at a certain frequency, and at the same time, it also serves as an oscillator coil. When the oscillator approaches a metal object underwater, it causes the metal object to produce an eddy current. Since the object to be salvaged is usually fairly big, and the search coil may get quite close to it, the magnetic field produced by the eddy current will be quite strong, and it will cause a marked drop in the inductance of the search coil and a corresponding rise in the frequency of the oscillator. If a fixed high-frequency signal produced by another oscillator, is mixed with the signal produced by the underwater oscillator, the value of the difference frequency will vary with what is underwater. When there is no metal object underwater, the frequencies of both oscillators are the same. When the object to be salvaged is approached, the value of the difference frequency changes from low to high. You can hear the audio signal in earphones. The closer you get the sharper the pitch. You can pretty much determine the location of the underwater metal object from the change in the sound in the earphones, and you can make out the rough outline of large objects (such as ships' hulls).

Although underwater detection often uses ultrasonic waves, when detecting metal objects, the eddy current method is more sensitive as well as simpler than ultrasonic waves.

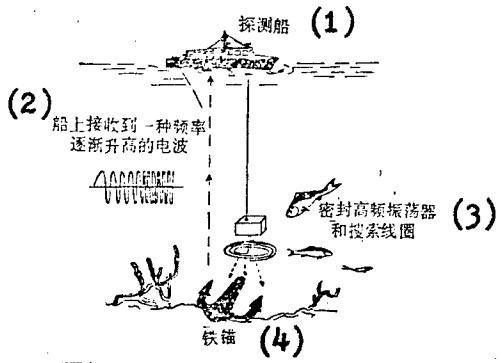

Figure 2. Diagram of Salvaging Sunken Equipment

Key:

1. Detection ship
2. Ship receives electric wave with gradually rising frequency
3. Sealed high-frequency oscillator with search coil
4. Iron anchor

Inspection for Metal Mixed in Materials

In a cement plant, if there are chunks of cast iron stuck in the material, it will damage the ball mill. In a chemical plant, if there are metal articles mixed in the raw material, it is even more intolerable. If the quantity of material is very large or if it is transported quickly, to use a person to inspect it would be almost impossible. Could we find a sensitive, accurate, fast method of inspection? Yes we could, that is to use metal detection technology.

A detection coil is placed underneath and parallel to the material conveyer belt. With an induction coil and a potentiometer, it forms a bridge. One diagonal of the bridge provides a high-frequency voltage. At both ends of the other diagonal is an output signal. When there is no metal object above the detection coil, the regulating potentiometer keeps the bridge balanced and there is no output signal. When a metal object is mixed in the material on the conveyer belt, the inductance of the detection coil changes, disbalancing the bridge, and there is an output signal. Iron mixed in the material raises the inductance and nonferromagnetic metals such as copper or aluminum lower the inductance. After the bridge output signal is amplified, it may be read out by an electric meter and it may also emit an audio alarm to alert the operator. At the same time, the drive relay cuts off the electric power and stops feeding the material. After the mixed-in metal is extracted, the conveyer belt proceeds.

Different from the two cases mentioned above, the position of the detection coil is fixed, the coil and object to be detected are closer together, a lower operating frequency may be used, the coil may consist

of more turns, the operation of the detector is more stable, and the sensitivity is higher.

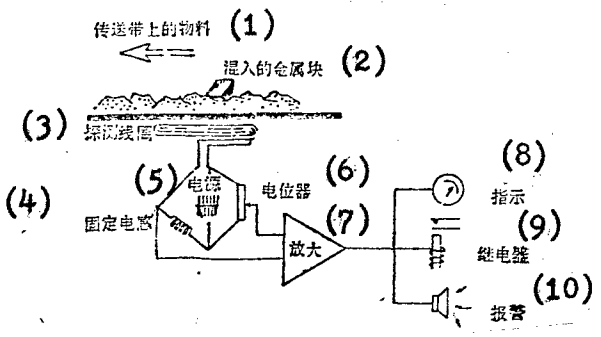

Figure 3. Diagram of Inspecting for Metal Mixed in Materials

Key:

1. Material on conveyer belt
2. Mixed-in piece of metal
3. Detection coil
4. Fixed inductance
5. Power supply
6. Potentiometer
7. Amplifier
8. Indicator
9. Relay
10. Alarm

Searching for Small Metal Objects Buried in the Ground

When archeological workers carry out excavations, they hope to know beforehand what is underground. Ultrasonic waves attenuate very fast when propagating in air or soil, and X-rays are difficult to take photographs in perspective. Neither are of any help, but using metal detectors can solve some of the problems. Buried objects are often very small, deep, and scattered, such as metal utensils or ancient coins. They require a high sensitivity and resolving power in the detector. Improving the detection methods and selecting the proper electronic circuits can raise the level of detection.

We know that if a high-gain amplifier (gain is the amplification capability of an amplifier) has a little positive feedback from the output end to the input end, it easily becomes a self-exciting oscillator. If a coil is attached to the output end of a high-gain amplifier, it forms a resonance circuit with the capacity. If another coil is attached to the input end and if the two coils are a certain distance apart and perpendicular to each other, the magnetic flux produced by the output coil cannot penetrate the input coil, that is, there is no induction coupling between them and the amplifier has no positive feedback. If there is a metal object under them, the eddy current of the metal causes a slight change in the distribution of the magnetic lines of force, some of the magnetic lines of force penetrate the input coil, inducing a positive feedback in the amplifier, and the circuit immediately begins to vibrate, emitting a high-frequency signal.

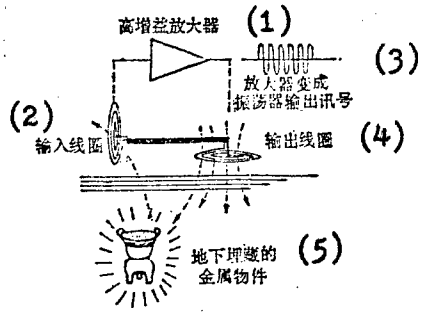

Figure 4. Searching for Buried Metal Objects

Key:

1. High-gain amplifier
2. Input coil
3. Amplifier becomes oscillator emitting a signal
4. Output coil
5. Buried metal object

In order to raise the detection sensitivity, the gain of the amplifier should be raised as much as possible so that the weakest eddy current will induce positive feedback causing self-excitation. To raise the resolving power, the magnetic lines of force of the output coil should not be overly dispersed but hopefully should be concentrated in a single beam so that any metal touched by the lines of force in that beam, will produce an eddy current. This kind of detector is also very useful in ship repair. Hidden iron nails in planks on ships up for repair often damage saws and planes and cause accidents. By using this instrument with high sensitivity and high resolving power we can inspect them beforehand. Even if the ship's planks have a thick coat of paint and you can't tell anything from the outside, you can still find each nail one by one. When repairing houses, you can also use them to check out whether the concrete has reinforcements.

The metal detection techniques described above, strictly speaking, should be called "magnetic-inductance metal detection" to distinguish them from ultrasonic wave or X-ray detection techniques. The sensitivity of ultrasonic detection is higher but since ultrasonic waves attenuate very fast in air and soil, the effective detection distance is very short. Besides, the reflectivity of many non-metal objects to ultrasonic waves is similar to metal and so there is no way of telling them apart. Although X-rays can make out metal very clearly, they can only inspect objects for detection inserted between an X-ray tube and a fluorescent screen (or photographic plate). Magnetic-induction metal detection stands in a class by itself.

From the examples above, you can see that besides serving as a useful means of detection and testing, it can also serve in a wide variety of automatic control devices. As the electronics industry grows, its applications will become ever wider and it will play an ever greater role in the struggle for production and in scientific experiments.

END

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